POWER PLANT ENGINEERING

THE PLANT ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY

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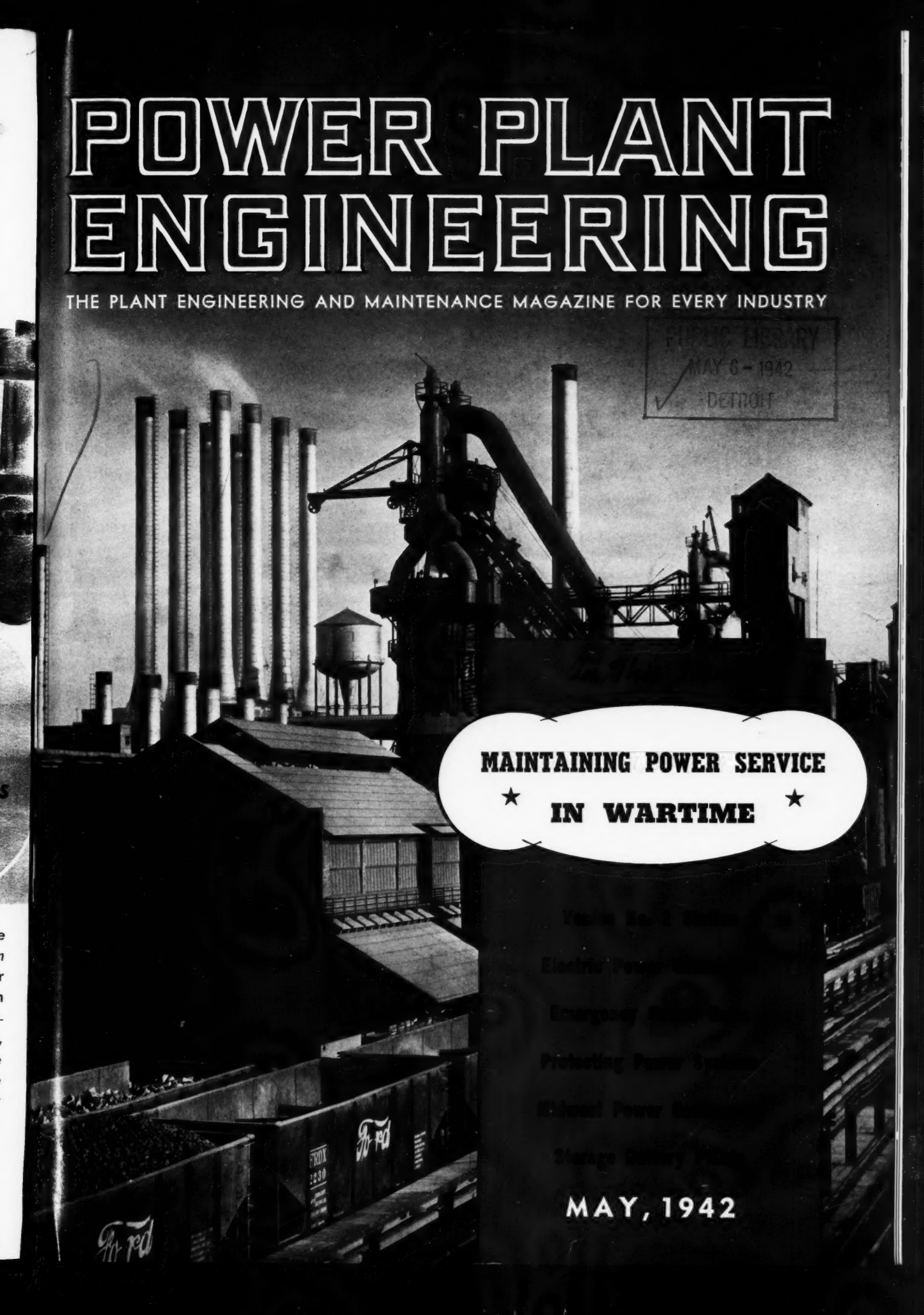
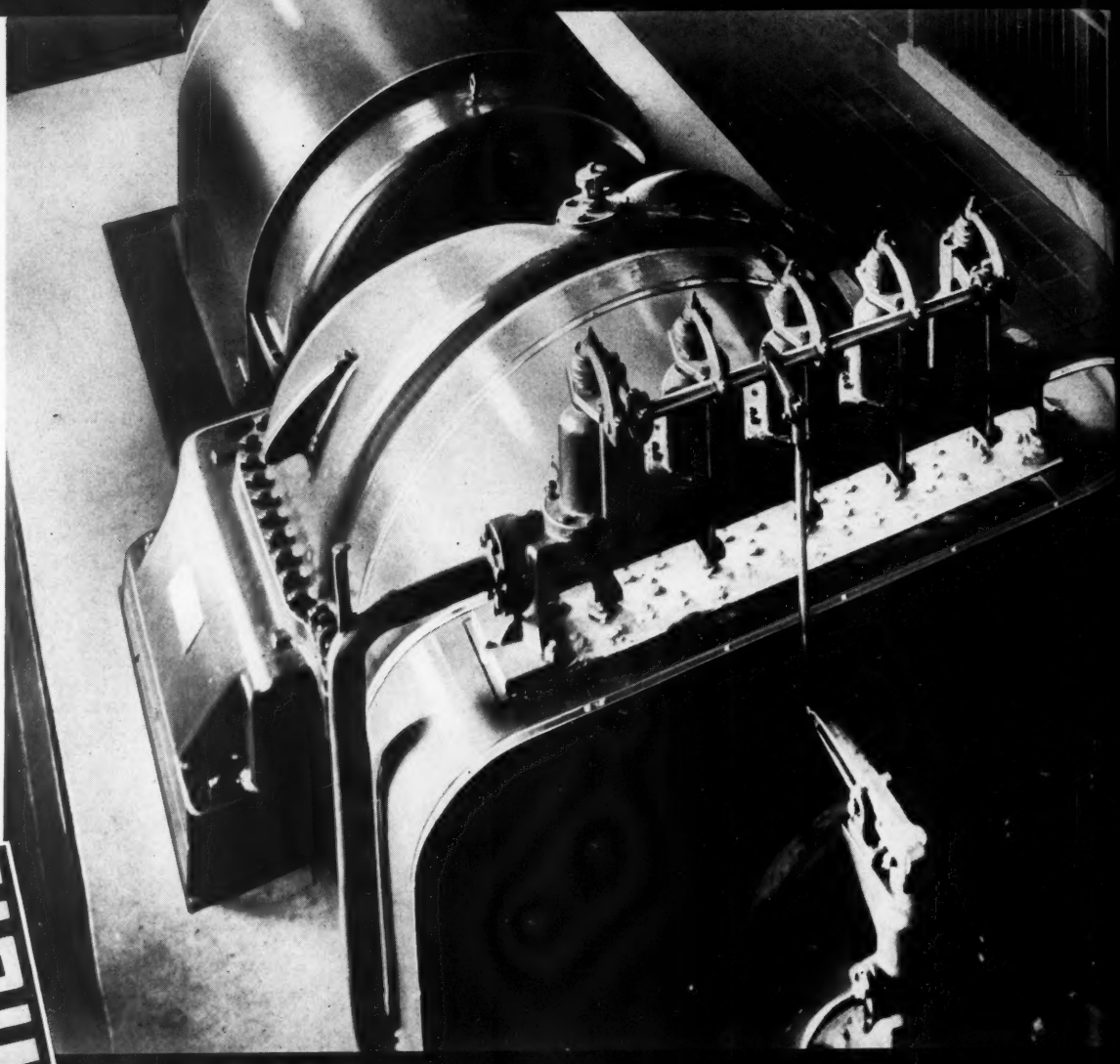


MAINTAINING POWER SERVICE ★ IN WARTIME ★

MAY, 1942

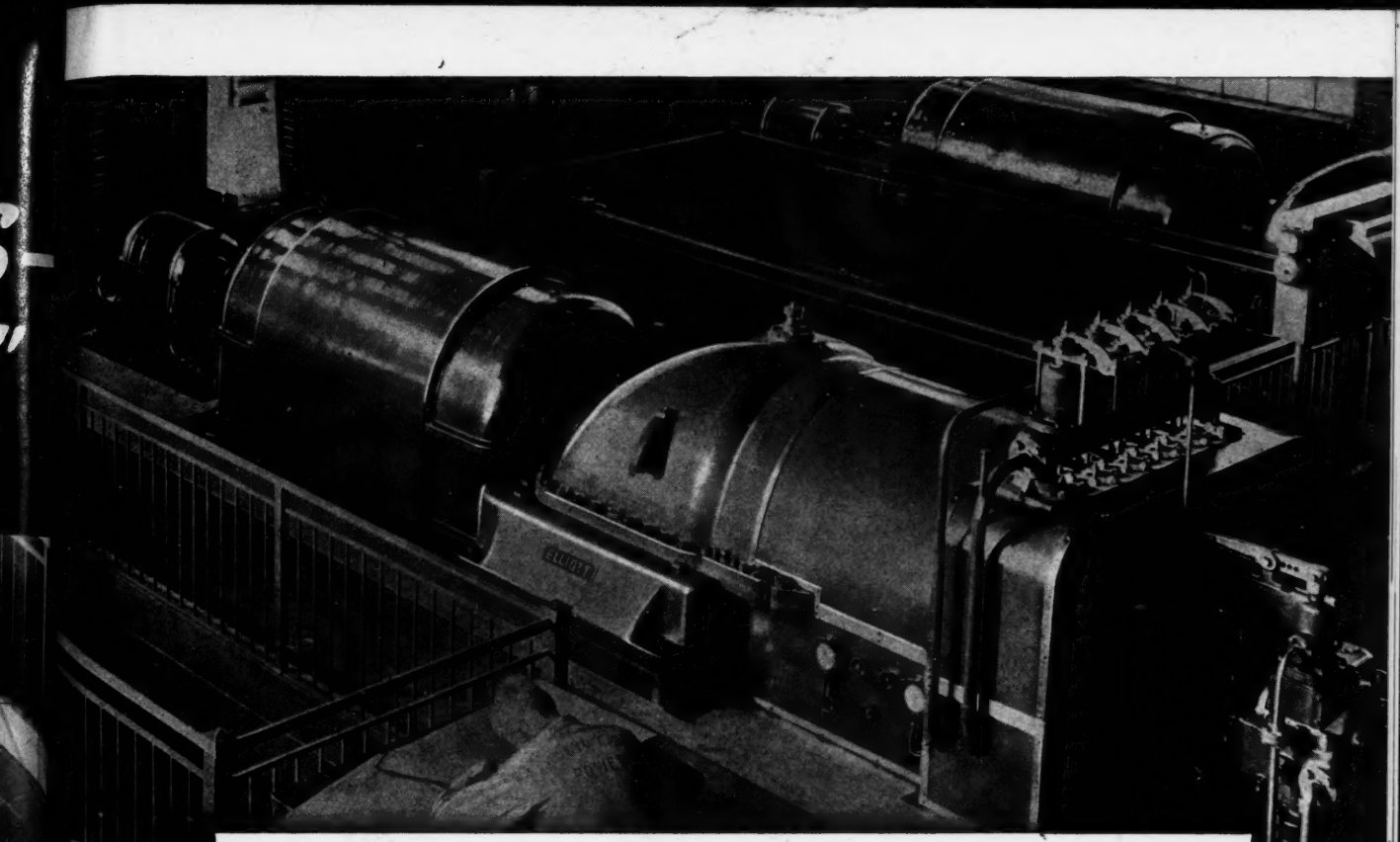
"RANGE TEN THOUSAND MILES— Commence Firing!"



ELLIOTT COMPANY

Steam Turbine Dept., JEANNETTE, PA.

DISTRICT OFFICES IN PRINCIPAL CITIES



THE BIG GUNS OF INDUSTRY ARE POWER GENERATING UNITS.

They fire not shells, but kilowatts. Their range is fantastically beyond that of any artillery, for their kilowatts will be felt at the far corners of the earth, in the planes, tanks, ships, guns, which Power builds.

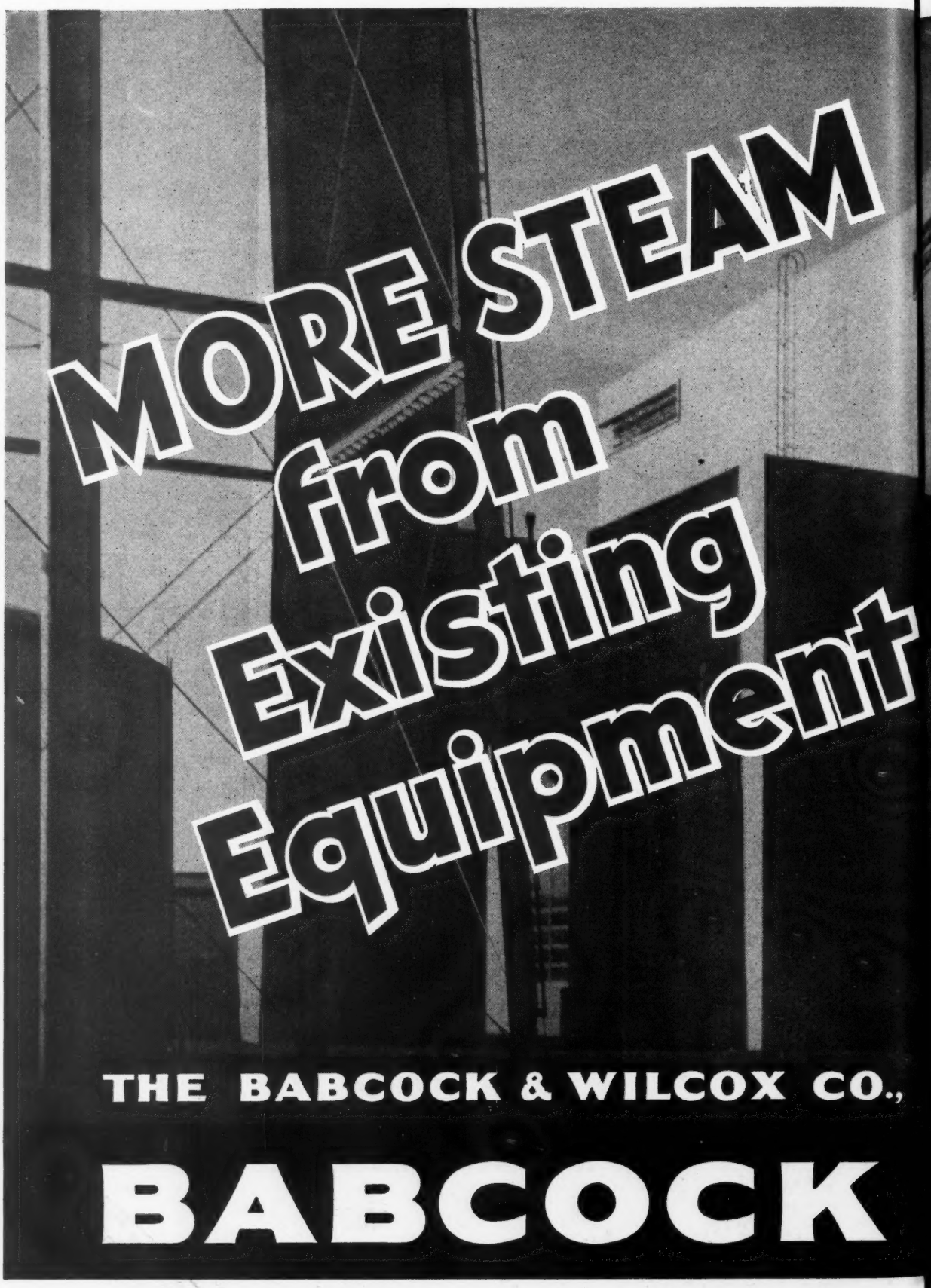
This war will be won by Power. To help win it, hundreds of Elliott turbine-generators like those pictured here, have "Commenced firing" in power plants everywhere. Elliott Company is bending every effort to put on the industrial firing line not only more, but better turbines, generators, and other related power equipment. In the central station shown here, the familiar Elliott monogram is found not only on the three turbine-generator units, but also on the surface condensers to which they exhaust, and on the feedwater heaters which serve the plant.

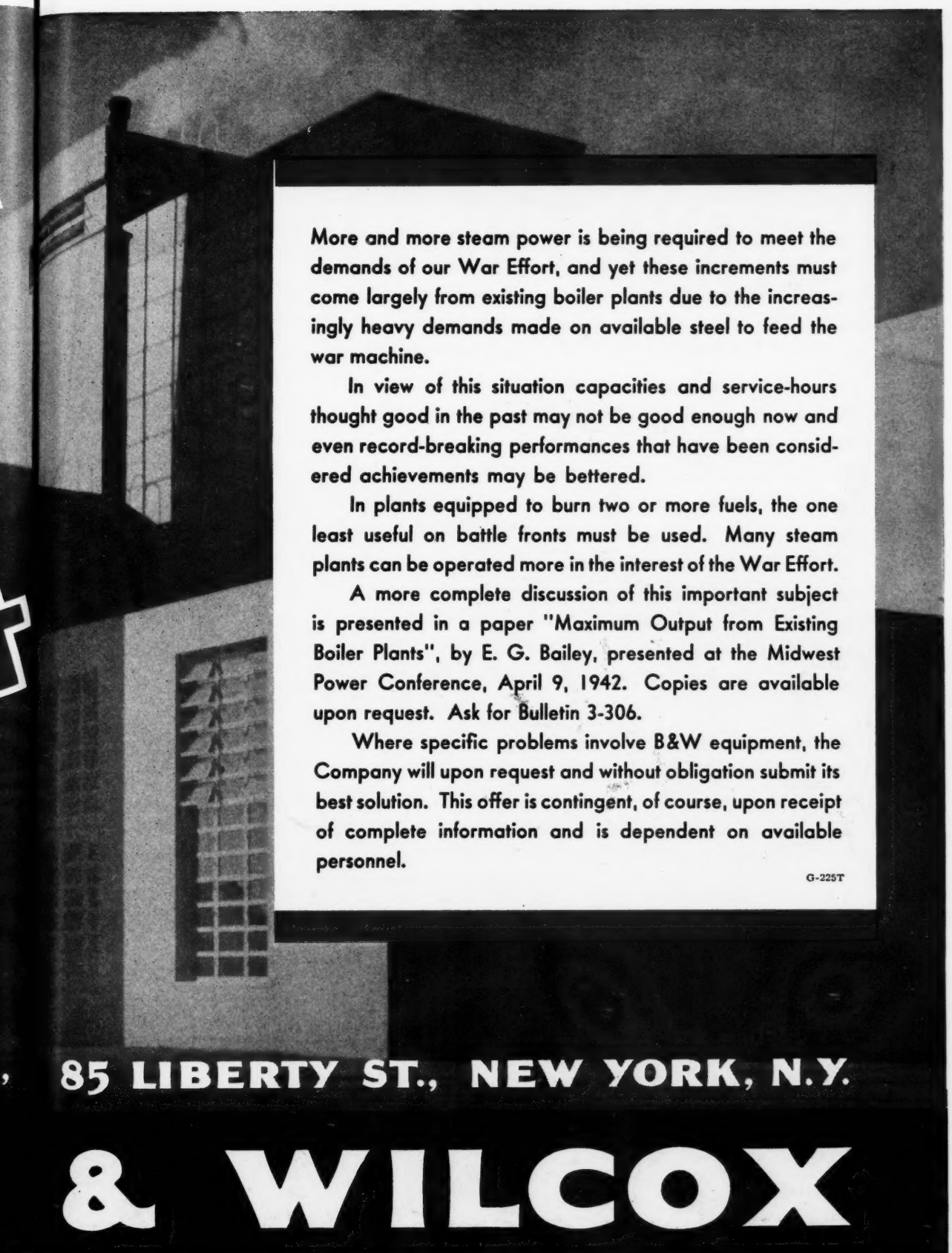
Elliott engineers are prepared at all times to subordinate all considerations to the vital duty of cooperating in any question of power generation, and to aid to the fullest extent of their ability.

H-655

Equipment on the war path:

TURBINE-GENERATORS • MECHANICAL DRIVE TURBINES • ENGINES
ENGINE-GENERATORS • MOTOR-GENERATORS • MOTORS
GENERATORS • CONDENSERS • STEAM JET EJECTORS
DEAERATORS • FEED-WATER HEATERS • DEAERATING HEATERS
CENTRIFUGAL BLOWERS • TURBOCHARGERS • DESUPERHEATERS • STRAINERS
SEPARATORS • GREASE EXTRACTORS • NON-RETURN VALVES • LAGONDA-LIBERTY TUBE CLEANERS


MORE STEAM
from
Existing
Equipment
THE BABCOCK & WILCOX CO.,
BABCOCK



More and more steam power is being required to meet the demands of our War Effort, and yet these increments must come largely from existing boiler plants due to the increasingly heavy demands made on available steel to feed the war machine.

In view of this situation capacities and service-hours thought good in the past may not be good enough now and even record-breaking performances that have been considered achievements may be bettered.

In plants equipped to burn two or more fuels, the one least useful on battle fronts must be used. Many steam plants can be operated more in the interest of the War Effort.

A more complete discussion of this important subject is presented in a paper "Maximum Output from Existing Boiler Plants", by E. G. Bailey, presented at the Midwest Power Conference, April 9, 1942. Copies are available upon request. Ask for Bulletin 3-306.

Where specific problems involve B&W equipment, the Company will upon request and without obligation submit its best solution. This offer is contingent, of course, upon receipt of complete information and is dependent on available personnel.

G-225T

85 LIBERTY ST., NEW YORK, N.Y.

& WILCOX

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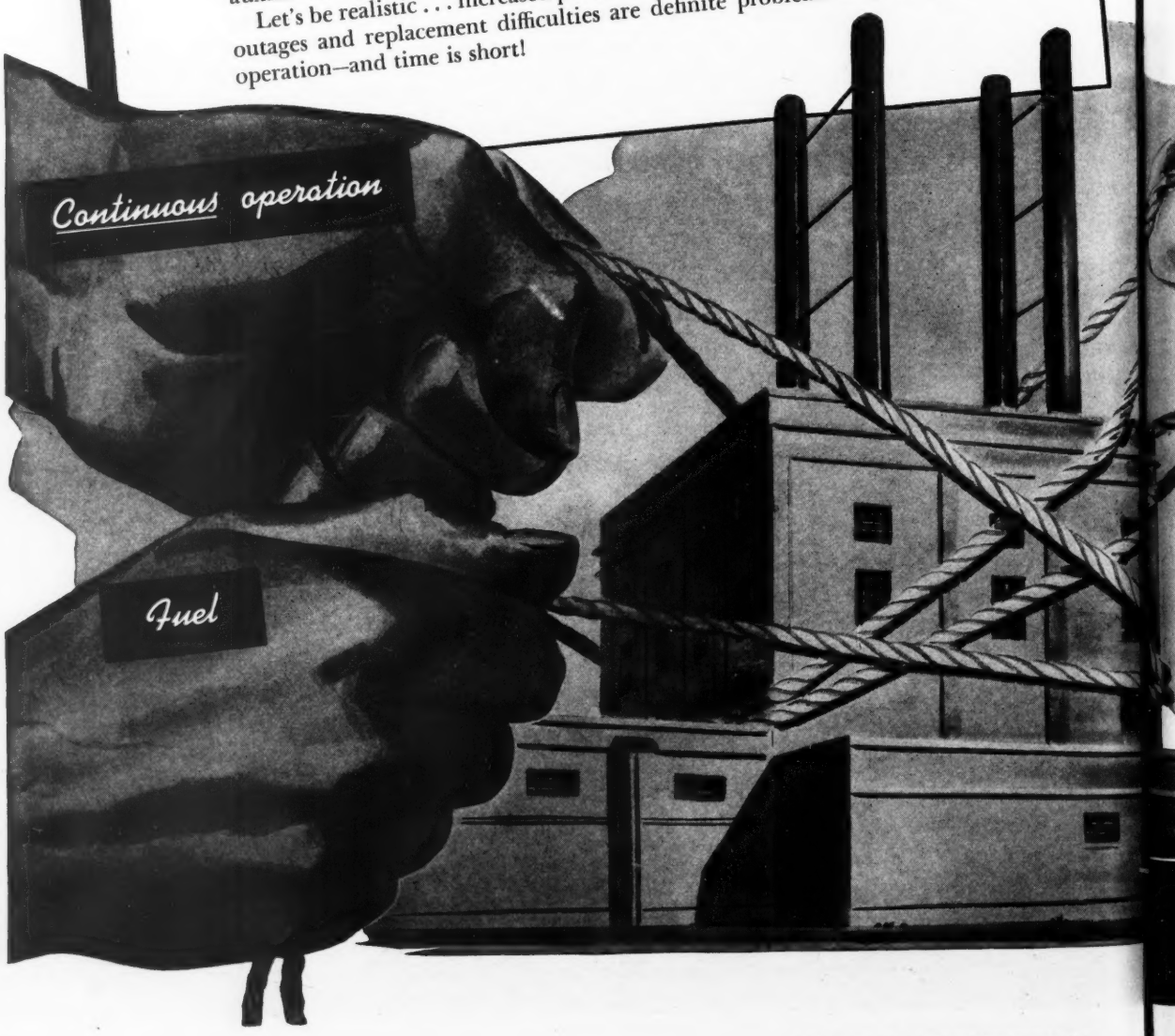
CAN YOUR PLANT STAND THE STRAIN?

Let's hope LESS and plan MORE — *Hoping* that our power plants survive the all-out effort ahead of us will not insure success. Foresight and careful planning to meet any contingency are absolutely essential *today*.

Modern boilers are tough . . . but 24-hour-a-day continuous operation at maximum capacity imposes a terrific strain, not only on boilers but on the auxiliaries upon which their successful operation depends.

Let's be realistic . . . increased production demands, fuel, labor turnover, outages and replacement difficulties are definite problems in your plant operation—and time is short!



This is how Hagan can help you

HAGAN Automatic Combustion Control provides a practical solution to many of the problems of continuous operation at peak capacity. For instance . . . you know that all adjustments will be made quickly and accurately, automatically removing the hazards of inexperienced personnel . . . you can be sure of uninterrupted operation and constant steam pressure, regardless of load demands. Hagan Control will carry on while operators are temporarily engaged in air raid drills and will operate the boilers at the right rate to carry the load.

With operating costs rising, you are assured that Hagan Control will produce the maximum amount of steam from every dollar's worth of fuel. In individual plants, fuel savings run as high as 6%.

With equipment replacements becoming increasingly difficult to obtain, the improved efficiency provided by Hagan Control reduces stoker outages and furnace maintenance, avoiding many unscheduled shutdowns and replacement delays.

In addition to the service it performs, you can rely on the Hagan Combustion Control system to remain on the job, year in and year out. Proper design, correct engineering and rugged construction make Hagan Control the logical choice today.

Now is the time for action. Write or wire us today! A thoroughly experienced Hagan combustion engineer will come at once to help you win your particular "battle of production." There's no obligation.

What you get with
HAGAN AUTOMATIC COMBUSTION CONTROL

Increased efficiency through correct proportioning of fuel and air.
Constant steam pressure.
Even distribution of load among boilers, or division as desired.
Maximum steam output per pound of coal.
Maximum efficiency even with inexperienced operators.
Fast, reliable operation without hunting.
Simplicity and ease of installation.
Elimination of smoke.
Lower power costs.
The engineering experience of the pioneers in automatic combustion control.

HAGAN CORPORATION · 300 ROSS STREET · PITTSBURGH, PA.

HAGAN *Automatic* COMBUSTION CONTROL

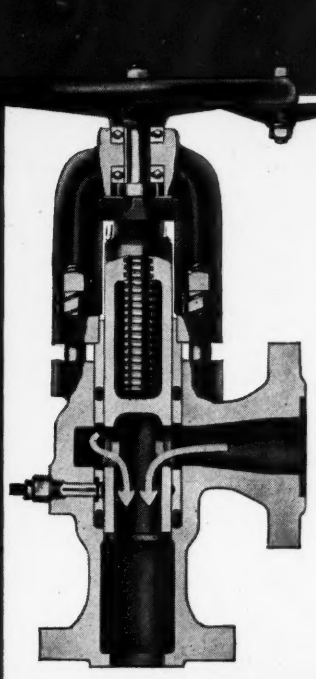
The pioneer . . . and still the leader

48 Yarway Blow-Off Valves S

The new Henry Disston and Sons, Inc., Power Plant. H. M. Wilson Company, Engineers.

YARWAY

Serve New Disston Power Plant



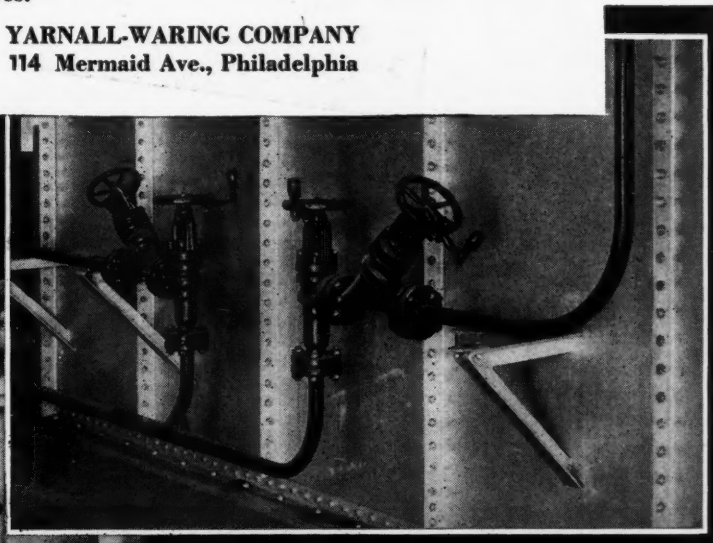
ANOTHER prominent industrial plant selects Yarway Seatless Blow-Off Valves—Henry Disston & Sons, Inc., Philadelphia, famous one-hundred-and-two-year-old saw, file and steel maker.

In this modern 600 lb per sq. in. pressure steam plant, 24 Yarway Type C Seatless Tandem Blow-Off Valves are in use—six on main boiler blow-down lines and eighteen on water-wall drains. *This tandem is equally suitable for blowing or draining and sealing.*

With "no seat to score, wear and clog with scale and dirt," the Yarway Seatless design is the most widely preferred blow-off valve—especially today, when the utmost in efficiency is demanded of all plant facilities.

There is a Yarway Valve for every pressure, purse and purpose. Write for Catalog B-421 for pressures up to 400 lbs. Catalog B-431 for higher pressures.

YARNALL-WARING COMPANY
114 Mermaid Ave., Philadelphia



Above: Two of the 18 Yarway Seatless Tandem Blow-Off Valves in use on water-wall drains.

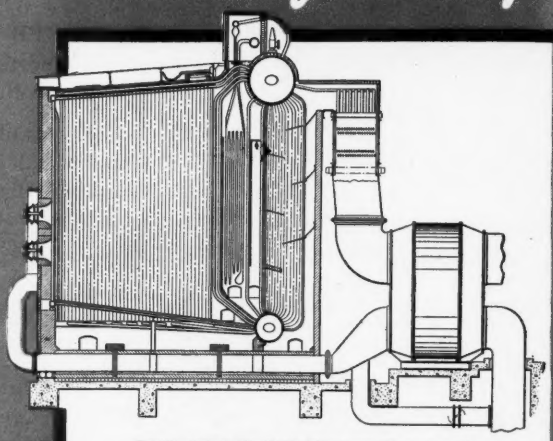
Left: Typical view of Yarway Seatless Blow-Off Valves on Main Boiler Blow-down Lines. Equally suitable for blowing or draining and sealing.

BLOW-OFF VALVES

COMBUSTION ENGINEERING'S VU AND

are suitable for any

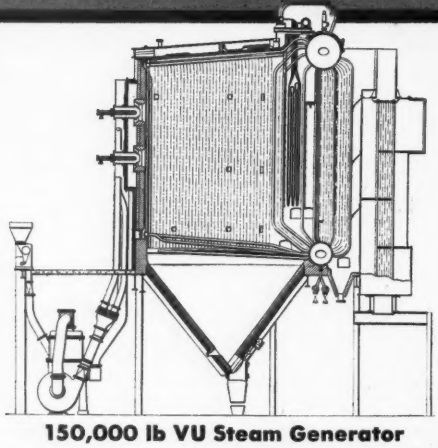
CAPACITIES
from 15,000
to 300,000
lb of steam per hr



300,000 lb VU Steam Generator oil-fired

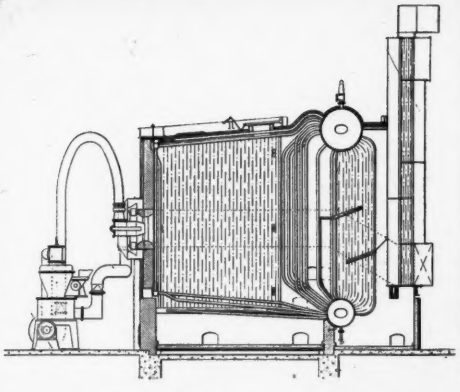
A semi-outdoor installation for a large southern public utility. Includes an Elesco Interbank Superheater and an Elesco Fin Tube Economizer. Design pressure—1000 psi. Total steam temp.—905 F.

Pulverized Coal, Oil, Gas Firing



150,000 lb VU Steam Generator pulverized coal or natural gas-fired

Installation of a mid-west transportation company. Includes Elesco Superheater and Tubular Air Heater. Firing equipment consists of C-E Raymond Bowl Mills and C-E Type R Burners. Design pressure—475 psi. Total steam temp.—735 F.



60,000 lb VU Steam Generator pulverized coal or oil-fired

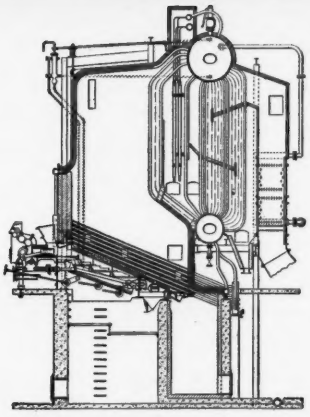
Installation of a southern textile mill. Firing equipment consists of C-E Raymond Bowl Mill and C-E Type R Burner. Design pressure—300 psi. No superheat.

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS, AND AIR HEATERS

COMBUSTION

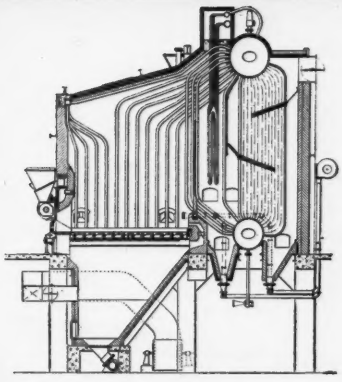
VU-Z STEAM GENERATORS

fuel or method of firing



70,000 lb VU-Z Steam Generator with C-E Multiple Retort Stoker

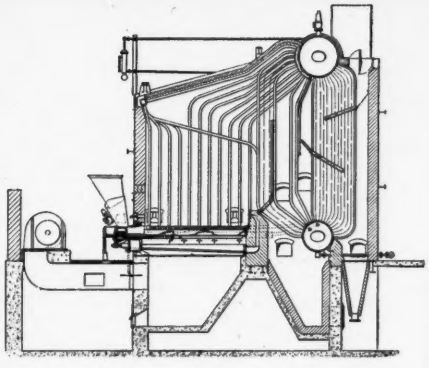
Installation of a large southern utility. Includes Elesco Interbank Superheater and Elesco Fin Tube Economizer. Design press.—250 psi. Total steam temp.—510 F.



38,800 lb VU-Z Steam Generator with C-E Spreader Stoker

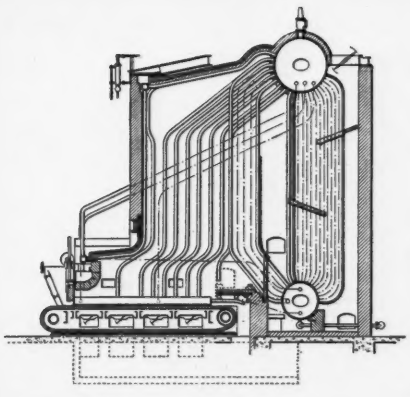
One of three VU-Z Units installed by a mid-west cement plant. Included are Elesco Interbank Superheaters. All three are fired by C-E Spreader Stokers. Design pressure—275 psi. Total steam temp.—468 F.

Various Types of Stoker Firing



35,000 lb VU-Z Steam Generator with C-E Type E Stoker

Installation of an eastern oil equipment manufacturer. Design pressure—200 psi. No superheat.



35,000 lb VU-Z Steam Generator with C-E Chain Grate Stoker

Installation for a mid-west confectionary plant Design pressure—200 psi. No superheat.

COMBUSTION ENGINEERING COMPANY, INC., 200 MADISON AVENUE, NEW YORK, N.Y. • CANADIAN COMBUSTION ENGINEERING CORPORATION, LTD., MONTREAL

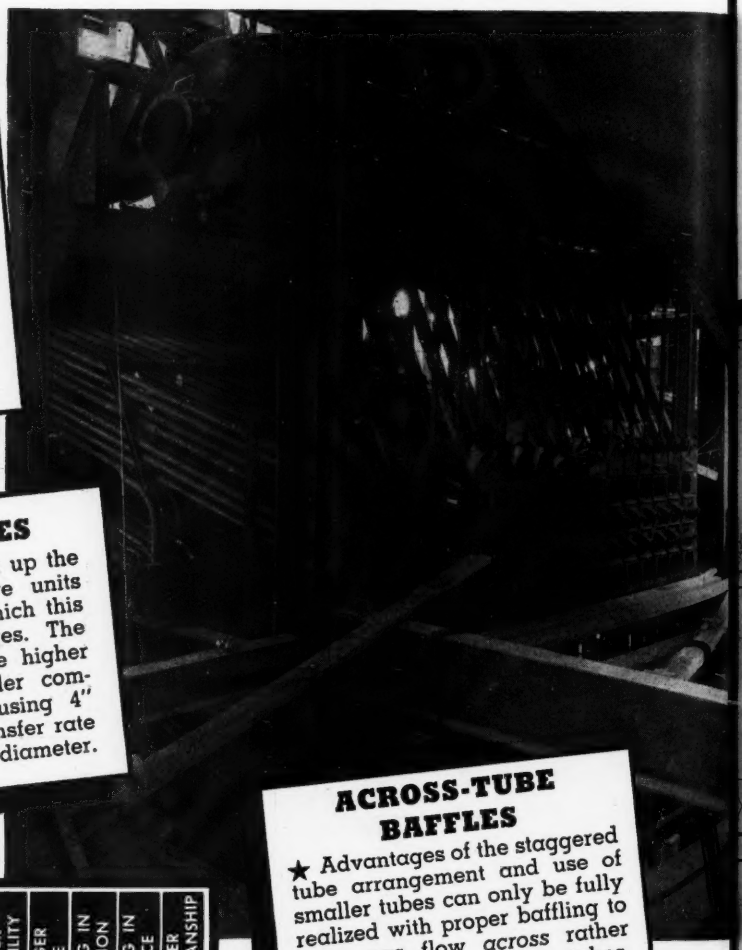
ENGINEERING

A-631

FEATURES THAT MEAN

SPRINGFIELD BOILERS

Erection pictures and cross-section drawing of one of the three new 80,000 lb. Springfield units at University of Illinois, Champaign, Ill. CONSULTING ENGINEERS: Sargent & Lundy.



EXCLUSIVE STAGGERED TUBE ARRANGEMENT

★ Losses caused by stratification and blow-thru of hot gases upward along straight vertical or diagonal lines are minimized by Springfield's distinctive, staggered 4-tube grouping which effectively breaks up the gas stream insuring good heat transfer.

USE OF SMALLER TUBES

★ Springfield uses 3" tubes to break up the water into smaller, more responsive units which accounts for the ease with which this boiler responds to rapid load changes. The smaller tubes also contribute to the higher efficiencies obtained with this boiler compared with competitive designs using 4" tubes, since the convection heat transfer rate is an inverse function of the tube diameter.

ACROSS-TUBE BAFFLES

★ Advantages of the staggered tube arrangement and use of smaller tubes can only be fully realized with proper baffling to force gas flow *across* rather than parallel with the tubes. Springfield uses sectional baffles designed to form an exceptionally tight and permanent across-tube baffle wall and arranged to force direct impingement of gases against tube surfaces — a feature that regularly accounts for lower exit gas temperature.

"PLUS VALUES" OFFERED BY SPRINGFIELD:	HIGHER EFFICIENCY	LOWER MAINTENANCE	HIGHER RELIABILITY	LONGER LIFE	SAVING IN ERECTION	SAVING IN SPACE	BETTER WORKMANSHIP
3" DIAMETER BOILER TUBES	✓						
STAGGERED 4-TUBE GROUPING	✓	✓			✓	✓	✓
ELECTRIC FURNACE STEEL HEADERS		✓	✓	✓	✓		✓
SECTIONAL 1-PIECE BAFFLES	✓	✓	✓	✓	✓		✓
CLOSE SPACING WATER WALLS	✓	✓	✓	✓			

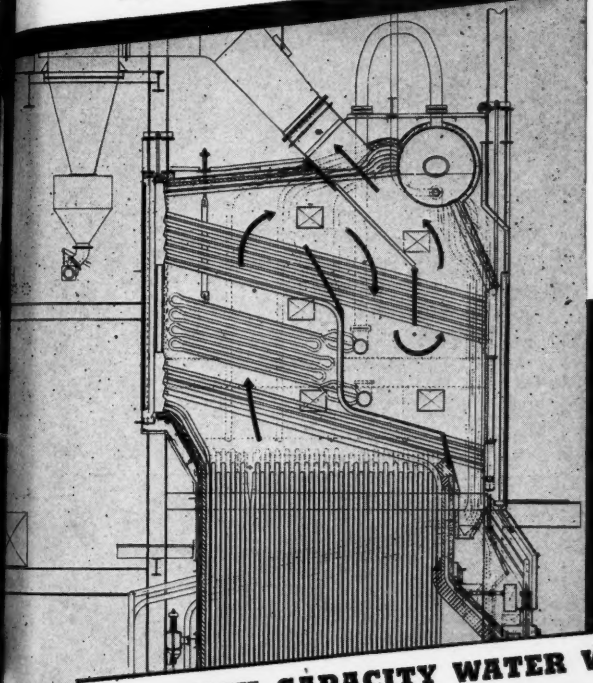
SPRINGFIELD

MODERN STEAM GENERATING UNITS

BETTER PERFORMANCE

SINGLE DRUM: EASY WATER LEVEL CONTROL, DRY STEAM

★ There is no *variable* steam space ahead of the steam drum in a Springfield boiler. As a result, there is none of the annoying shifting of water volume that can cause carry-over and other serious trouble under sudden load changes. Springfield's reputation as a dry "steamer" is backed by numerous independent records.



FEATURES found only in Springfield boilers are largely responsible for the extra dividends they pay in lowered operating costs and increased service hours. The "Springfield Design" is not just another way of arranging tubes, drums, baffles, etc. Rather, it is the utilization of certain fundamental principles in design to secure specific benefits.

At the present time, organizations engaged in defense work, or otherwise able to obtain priority ratings, can get quicker delivery — save money — and aid in conserving metals on steam plant requirements by taking advantage of the distinctive construction features of Springfield straight tube, cross drum, sectional header boilers. Complete drawings, patterns, shop fixtures, etc., are on hand to duplicate any of the many modern Springfield steam generating units built in recent years. Capacities from 5000 lbs. to 450,000 lbs. per hour, or more. Pressures from 75 lbs. to 750 lbs., or higher. Springfield regularly takes contracts for complete steam generating units. Write, phone, or wire for quotations. SPRINGFIELD BOILER CO., 1951 E. Capitol Ave., Springfield, Illinois.

HIGH CAPACITY WATER WALLS

★ Springfield close-spaced water walls have been developed to provide the maximum in overload capacity. By dividing the work and reducing steaming rates in the individual tubes, the whole installation is made less sensitive to local overheating, bad water conditions, and other unfavorable conditions which may occur in average operation. Springfield continues to pioneer in the development of water cooled furnaces having installed the first commercially successful water walls in this country in 1923, the first close spacing water walls in 1928, and the first large center water wall (divided furnace) in 1937.

BOILER CO.

ANY SIZE • ANY FUEL • ANY PRESSURE

In Springfield

Ohio Edison Company's Mad River electric generating station. In circle, upper right, the Company's modern Springfield, Ohio, headquarters.

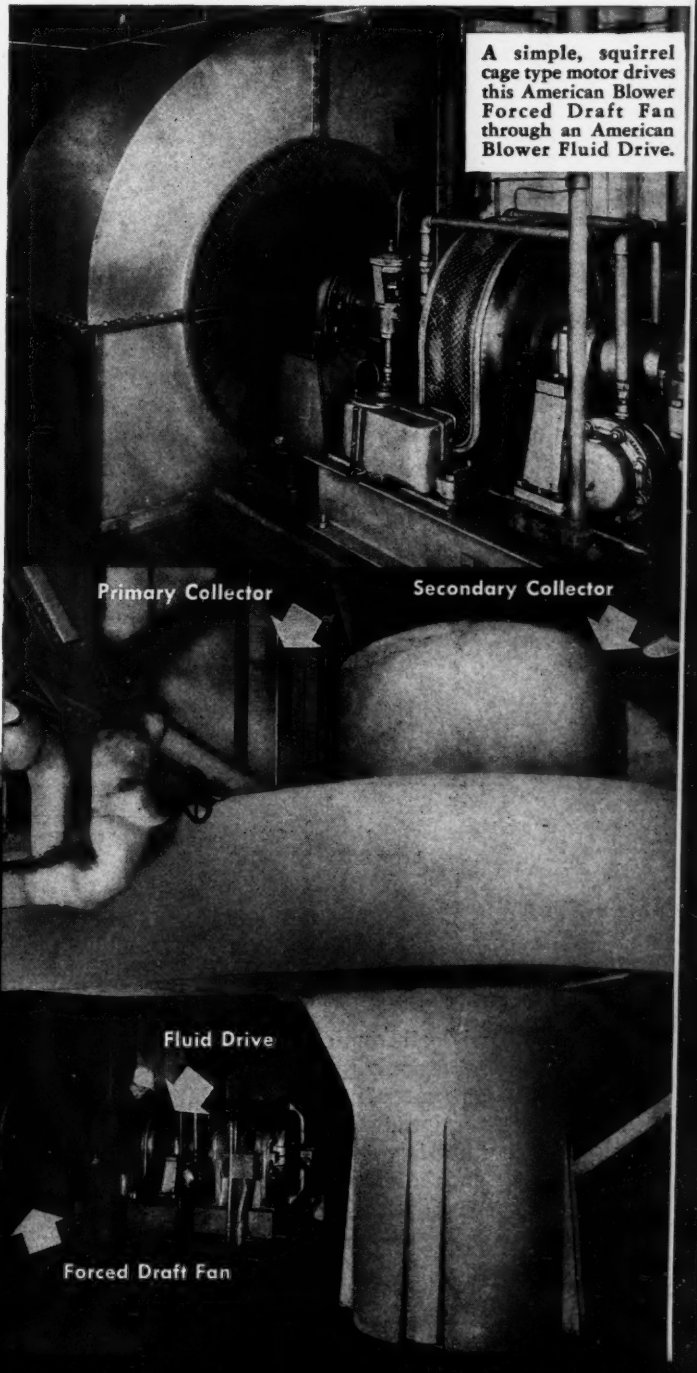
HIO EDISON

paces production

Springfield's early industries—woolen, cotton, flour and powder mills — were important factors in the rapid development of central Ohio. Water power from Lagonda Creek and Mad River turned the wheels, paced production. New generations expanded old industries, brought new; set up new standards of efficiency and speed. Now, electric power — abundant, dependable and cheap—paces production. The Ohio Edison Company is keenly aware of its community's dependence upon it—not only by the scores of industries "all-out for Victory," but by civic, commercial and rural customers, all working toward the same goal. We are proud that American Blower Forced and Induced Draft Fans, Fluid Drives and Dust Precipitators were selected by the Ohio Edison management in their foresighted planning of electric generating facilities to meet today's emergency requirements. May we have the privilege of serving you?

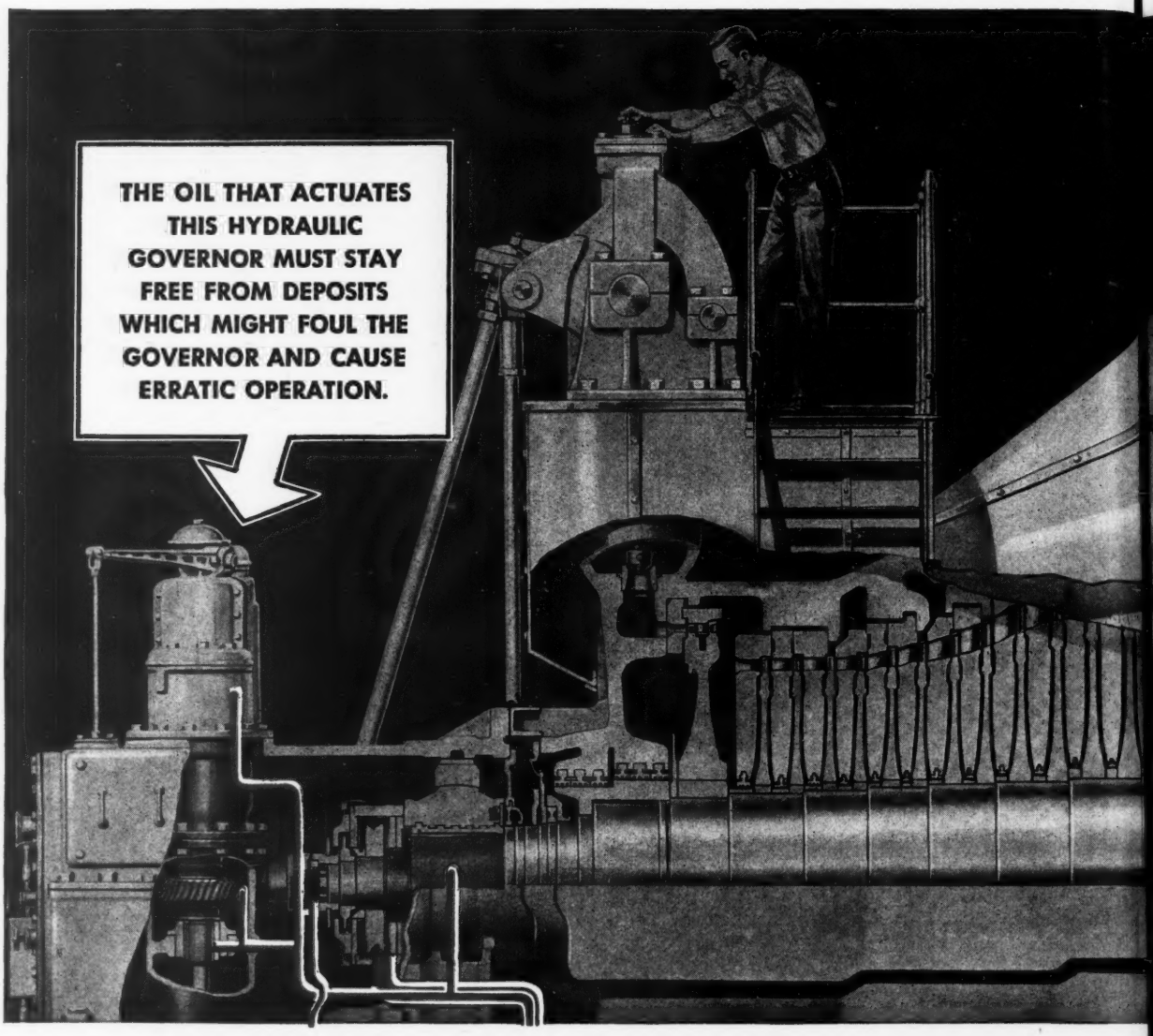
AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT, MICH.
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONT.
Division of AMERICAN Radiator and "Standard" Sanitary Corporation



A simple, squirrel cage type motor drives this American Blower Forced Draft Fan through an American Blower Fluid Drive.

An American Blower Induced Draft Fan, driven through an American Blower Fluid Drive, in the Mad River Station of the Ohio Edison Company.


THE OIL THAT ACTUATES THIS HYDRAULIC GOVERNOR MUST STAY FREE FROM DEPOSITS WHICH MIGHT FOUL THE GOVERNOR AND CAUSE ERRATIC OPERATION.

How to Choose a Turbine Oil—

READ THESE PERTINENT FACTS ABOUT THE FUNDAMENTAL JOBS A LUBRICATING OIL MUST DO:

Problem: This cutaway picture of a steam turbine shows how bearings and hydraulic governor are furnished with oil from one big circulation system. The oil must not only lubricate but also carry away large amounts of heat conducted from the extremely hot turbine steam through the shaft to the bearing. It must have the stability needed to resist oxidation and the formation of deposits which might "starve" bearings and foul the governor.

Answer: ***Gargoyle D.T.E. Oils*** have proved by actual service in more than 51% of the U.S.A.'s major-sized steam turbines that they are ideal for this lubrication job. These oils were the ***first*** oils specifically made for steam turbines. They have been constantly improved, and today, no other turbine oil can even approach the record of "D.T.E.'s" for long-term, reliable service in so great a number of steam turbines.

THE OIL MUST RESIST
THE EFFECTS OF PRESSURE
AND HIGH SUSTAINED
TEMPERATURES TO
PROTECT PRECISION-MADE
TURBINE BEARINGS.
TO HELP MAINTAIN WARTIME PRODUCTION, CALL IN
SOCONY-VACUUM
for "Correct Lubrication"
GARGOYLE
Lubricants
SOCONY-VACUUM OIL CO., INC. — Standard Oil of N. Y. Div. — White Star Div.
Lubrite Div. — Chicago Div. — White Eagle Div. — Wadhams Div. — Southeastern Div.
(Baltimore) — Magnolia Petroleum Company — General Petroleum Corporation of Calif.

BIG TURBINE FEATURES

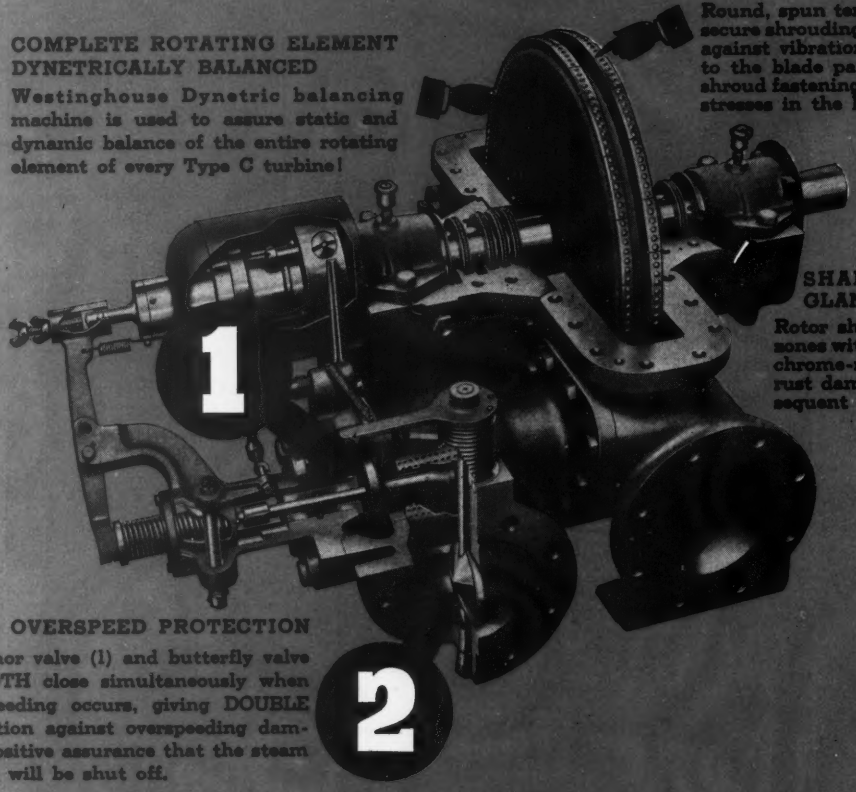
FROM 5 HP UP

COMPLETE ROTATING ELEMENT DYNETRICALLY BALANCED

Westinghouse Dynetric balancing machine is used to assure static and dynamic balance of the entire rotating element of every Type C turbine!

SPUN TENONS SECURE THE SHROUDS

Round, spun tenons at the blade ends secure shrouding, which stiffens blades against vibration, and confines steam to the blade path. Result: a uniform shroud fastening, without setting up of stresses in the blades.



SHAFT PROTECTED AT THE GLAND ZONES

Rotor shaft is protected at the gland zones with a sprayed-on surface of high chrome-nickel steel alloy. This prevents rust damage to carbon rings and consequent steam leakage.

DUAL OVERSPEED PROTECTION

Governor valve (1) and butterfly valve (2) BOTH close simultaneously when overspeeding occurs, giving DOUBLE protection against overspeeding damage, positive assurance that the steam supply will be shut off.

why steam headquarters can give you the "most turbine for the money!"

- **DUAL PROTECTION**—Overspeeding trips two valves at once.
- **SPARKLESS OVERSPEED TRIP**—(When required by operating conditions) with Micarta insert.
- **SHAFT PROTECTION**—Shaft sprayed with high chrome-nickel steel at the gland zones to prevent rust-cutting of carbon rings.
- **SPUN TENONS**—Provide a smooth, secure shroud fastening without stresses.
- **DYNETRICALLY BALANCED ROTOR**—Entire rotating element dynamically balanced.
- **CONTOURED STEAM PATH**—All nozzle and blade contours designed for maximum efficiency.
- **CHROME-ALLOY BLADES · ACCURATE SPEED REGULATING GOVERNOR · BABBITT-LINED BRONZE BEARINGS · STEAMTIGHT, FINISH GROUND CASING FLANGES · CYLINDRICAL STEAM STRAINER AROUND INLET VALVE · NO SOFT PACKING ON INLET VALVE STEM.**

All Westinghouse Turbine designs have their basis in the same great pool of engineering experience. The same research technique, the same design standards, the same manufacturing facilities—are available for development of a 5 hp turbine or a 100,000 kw turbine-generator. And beyond this specialized ability to build turbines is Steam Headquarters' broad experience covering virtually the entire field of steam equipment.

It takes that kind of an organization to build BIG TURBINE FEATURES into economical, general purpose turbines. That's what we've done with the family of Westinghouse Type C Turbines. You'll find in them a combination of features present in no other turbines except in much larger ratings. You'll find in them the "most turbine for the money!" For complete information write for Booklet 2230-A, Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa., Dept. 7-N.

J-50406

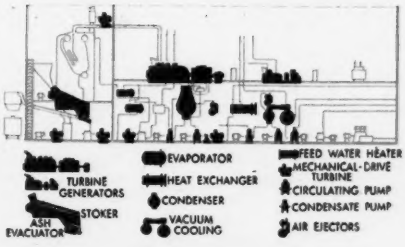
extra values in all these products of steam headquarters

1. equipment

A complete range of steam turbines for mechanical or generator drive, from 5 hp to the largest . . . with a full line of auxiliary steam equipment.

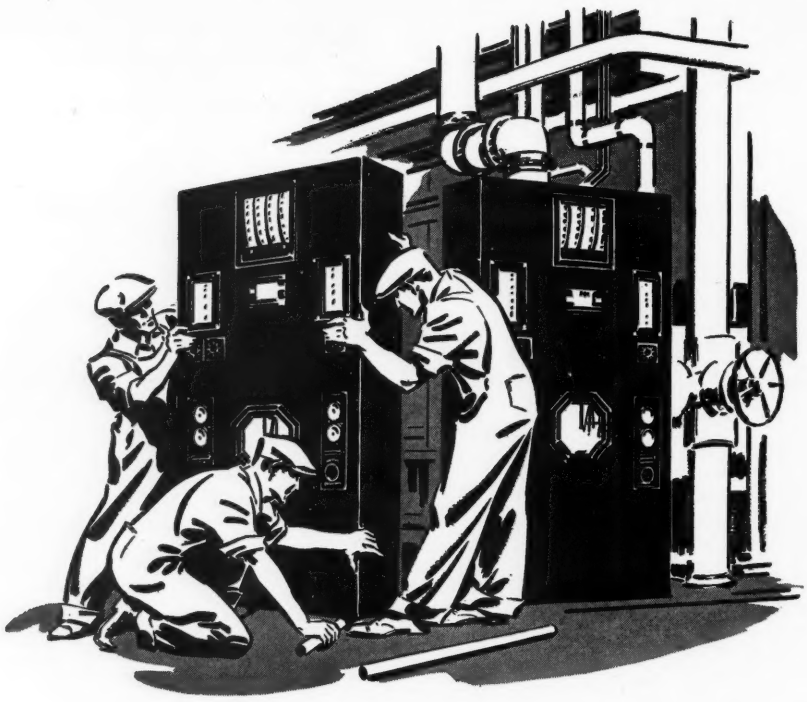
2. engineering

A complete engineering service to help you select and apply the steam equipment best suited to your requirements.



WESTINGHOUSE

Westinghouse



Repeat Orders Don't Just Happen!

IN THE COMBUSTION FIELD THEY ARE EARNED BY GOOD ENGINEERING

★

A true automatic combustion control system requires not only good mechanical equipment but also sound engineering of the complete system. It is a far cry from a machine that can operate a damper or valve to a system that is capable of theoretically perfect combustion control and still answers the demands of everyday operation.

Every Republic-Smoot combustion control system is engineered to co-ordinate the operations of all units and to meet the specific requirements of a particular installation. It is

this engineering skill and service that has earned for Republic the reputation reflected in the large number of repeat orders from many of America's leading industrial plants.

Built into the Republic-Smoot combustion control systems are many features that will enable you to operate your boiler (or boilers) over long periods at test efficiencies regardless of variations in fuel, load and other operating factors.

Check the following features against your list of "musts" for a perfect combustion control system.

✓ **CENTRALIZED CONTROL:** The operation and control of the boiler or boilers is centralized at the master controller panel.

✓ **FUEL-AIR RATIO INDICATOR:** The master controller is provided with mercury manometers which indicate the measured fuel and air inputs to the boiler and the fuel-air ratio.

✓ **FUEL-AIR RATIO ADJUSTMENT:** A handwheel on the front of the master control panel provides a convenient means for adjusting the fuel-air ratio.

✓ **ALL BOILER RATINGS:** Automatically maintains proper fuel-air ratio over the entire range of boiler ratings.

✓ **CONSTANT STEAM PRESSURE:** Automatically maintains the plant steam pressure within narrow limits of variation by proportioning the fuel and air inputs to the load.

✓ **LOAD DISTRIBUTION:** Provides a means of distributing the load among the boilers as desired.

✓ **MANUAL CONTROL:** Individual regulators can be controlled manually by a handwheel located on the front of the master panel.

Republic's engineering department is at the service of power plant operators to assist them in meeting today's increased power demand. A 'phone call to our nearest branch office or a letter to our main office will bring a Republic engineer to your plant promptly. He will be glad to co-operate with you in the solution of any metering or control problem you may have. Why not take advantage of his technical training right away?

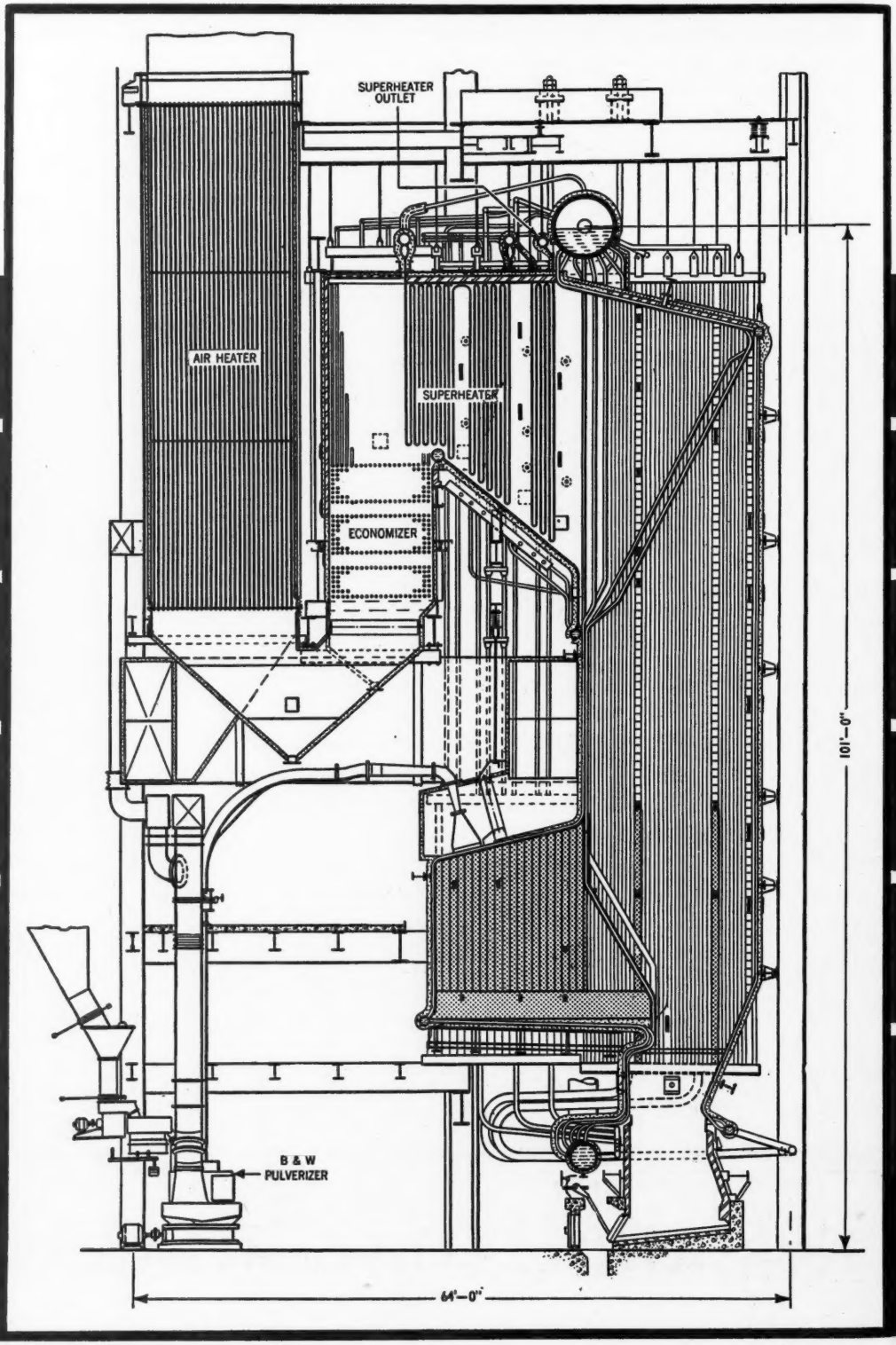
A PARTIAL LIST OF REPEAT ORDER CUSTOMERS

Alabama Power Co.
Albemarle Paper Mfg. Co.
American Sugar Refining Co.
American Viscose Corp.
Beechnut Packing Co.
Celanese Corp. of America
Central Illinois Pub. Service Co.
City of Clay Center
Consolidated Cement Corp.
Commonwealth Edison Co.
Darling & Co.
E. I. du Pont de Nemours & Co.
City of Fort Collins
Globe Oil & Refining Co.
Hawaiian Electric Co.
Ladish Drop Forge Co.
Marshall Municipal Utilities
Picatinny Arsenal
Pratt-Whitney Div., United Aircraft Corp.
Produce Terminal Corp.
Shell Oil Co.
Southern Kraft Corp.
Standard Forgings Corp.
Stroh Brewing Co.
Studebaker Corp.
Sutherland Paper Co.
United Illuminating Co.
U. S. Brewing Co.
U. S. Military Academy
U. S. Navy, Norfolk Navy Yard
U. S. Naval Operating Base, Norfolk
U. S. Navy, Charleston Navy Yard
West Virginia Pulp & Paper Co.
Worcester Salt Co.
Wright Aeronautical Corp.

Republic Flow Meters Co.

2224 Diversey Parkway • Chicago, Illinois

52 B & W


SUPERHEATER OUTLET
AIR HEATER
SUPERHEATER
ECONOMIZER
B & W PULVERIZER
101'-0"
64'-0"

Radiant Boilers

ordered to date

21,000,000 lb. steam per hour

Combined Capacity

FUELS—

Pulverized Coal
Oil and Gas
Oil, pulverized coal in future
Gas, oil, or acid sludge, with possibility of pulverized petroleum coke in future

CAPACITIES—

60,000 to 900,000 pounds of steam per hour

PRESSURES—

525 to 1525 pounds per square inch

STEAM TEMPERATURES—

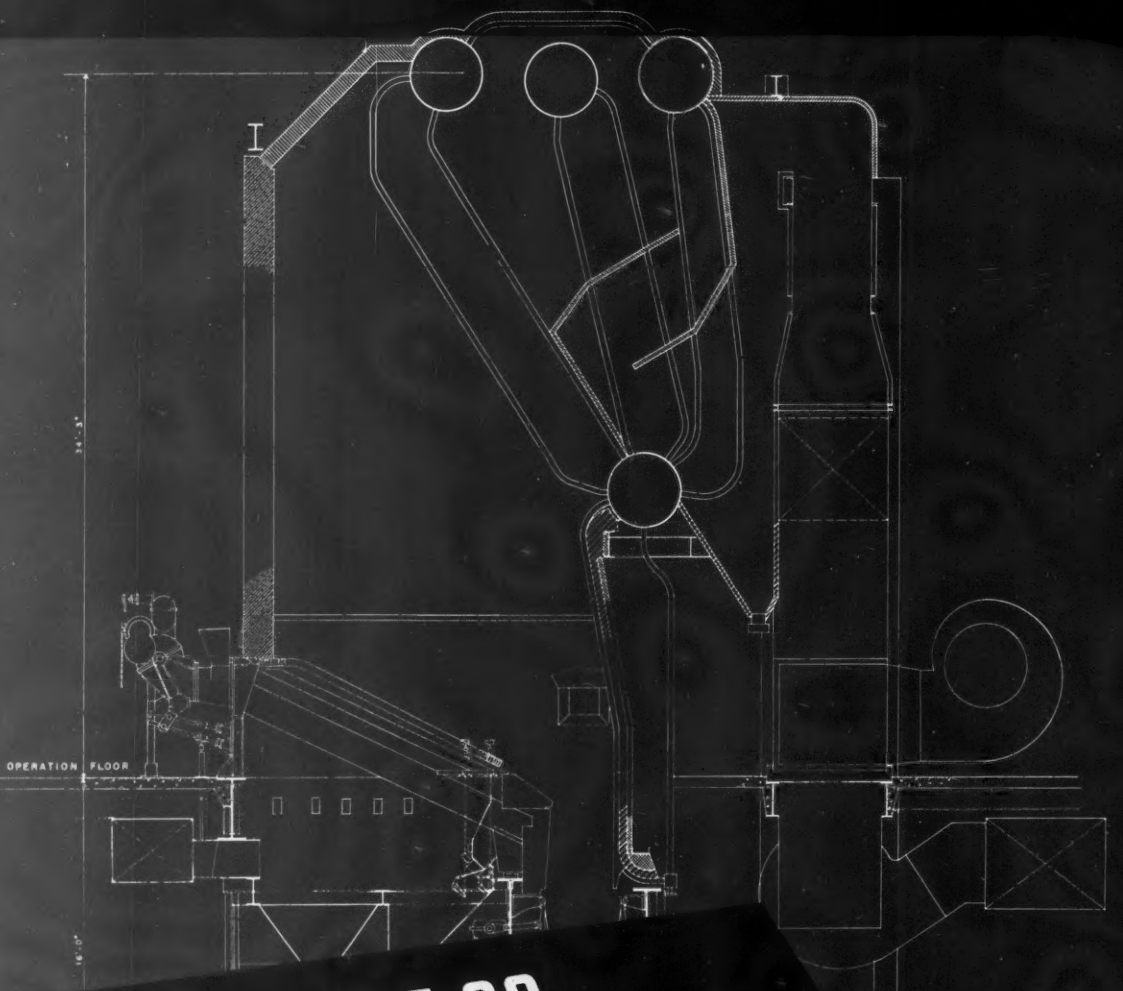
800 to 950 degrees Fahrenheit

THE BABCOCK & WILCOX COMPANY
85 LIBERTY STREET . . . . . NEW YORK, N. Y.

BABCOCK & WILCOX

G-202TA

WITH LARGE STEAM USERS IT'S A-E-CO TAYLOR STOKERS



A-E-CO
TAYLOR STOKER

AMERICAN ENGINEERING

A-E-CO TAYLOR STOKERS, WATER WALLS, ASH HOPPERS, HELE-SHAW FLUID POWER, LO-HEAD

TAKE A CASE IN THE PAPER INDUSTRY

PROBLEM:

Several years ago a paper plant, large user of steam, needed more capacity and a wider range of steam generation. Their equipment, consisting of eight boilers fired by early model stokers, realized an efficiency of only 68 to 70%.

SOLUTION:

A single high pressure boiler, with rated continuous capacity of 130,000 lbs. per hour, fired by a Taylor Air Cooled Stoker was installed. The unit was equipped with economizer, airheater and side and rear walls.

RESULTS:

1940-41 inclusive.

Total Steam Generated	1,746,970,000 lbs.
Total Coal Burned	170,139,000 lbs.
Average Actual Evaporation	10.26 lbs. S/lb. coal
Average Efficiency	84.1%
Preheated Air Temperature to Stoker	300-335°F.
Average Operating Conditions	
Steam Pressure	420 lbs. Ga.
Total Temperature	605°F.
Feed Temperature to Economizer	212°F.
Heating Value of Coal, as Fired	13,710 B.T.U.
Range of Steaming Capacity	25,000-145,000 lbs./hr.
Total Hours 1940-1941	17,544
Total Time Unit in Service	16,860
Availability Factor of Entire Unit	96.1%

A-E-CO TAYLOR STOKERS ON THE FIRING LINE

*Aluminum Company of America, Edgewater, N. J.
*Aluminum Company of America, New Kensington, Pa.
American Tobacco Co., Inc., Durham, N. C.
Cazenovia Paper Company, Johnsonburg, Penna.
Chrysler Corporation, De Soto Plant, Detroit, Mich.
*Collins and Aikman Corp., Roxboro, N. C.
City of Columbus, Ohio
Consolidated Paper Company, Monroe, Michigan
*Cresson State Sanitarium, Cresson, Penna.
Defiance Milk Products Co., Defiance, Ohio
*DeLaval Steam Turbine Co., Trenton, N. J.
*Detroit Sulphite Pulp & Paper Co., Detroit, Michigan
City of Dover, Ohio
*Draper Corporation, Hopedale, Mass.
Erwin Cotton Mills Co., West Durham, N. C.
*Fisher Body Corporation, Detroit, Michigan
Fisher Body Corporation, Fleetwood Plant, Michigan
*Fisher Body Corporation, Grand Rapids, Michigan
*Fisher Body Corporation, Pontiac, Michigan
Fox Paper Company, Lockland, Ohio
Froedtert Grain and Malting Co., Milwaukee, Wisc.
*City of Gallion, Ohio
*Gardner-Richardson Company, Lockland, Ohio
*General Electric Company, Erie, Penna.
*General Electric Company, Fort Wayne, Ind.
*Greenwood Electric L. & W. Plant, Greenwood, Miss.
*Board Public Works, Hannibal, Mo.
Hill School, Pottstown, Penna.
*Hobart Mfg. Co., Troy, Ohio
*City of Holland, Michigan
*Hope Natural Gas Co., Cornwell Station, West Va.
Hudepohl Brewing Co., Cincinnati, Ohio
Industrial Cotton Mills, Rock Hill, S. C.
*City Water & Light Plant, Jonesboro, Ark.
Kohler Company, Kohler, Wisc.
Maryland State Penal Farm, Roxbury, Md.
*Maybury Sanitarium, Northville, Michigan
Michigan Carton Company, Battle Creek, Michigan
*Michigan State College, East Lansing, Mich.
Municipal Light Plant, Marshfield, Wisc.
*Pacific Mills, Lyman, S. C.
*Packard Motor Car Co., Detroit, Michigan
*Municipal Electric Plant, Pattersville, Ohio
*Park Drop Forge, Cleveland, Ohio
*Pennsylvania Electric Co., Seward, Penna.
*Pennsylvania R. R. Co., Philadelphia, Penna.
*Picatinny Arsenal, Dover, N. J.
*Pittsburgh Plate Glass Co., Barberton, Ohio
Borough of Quakertown, Quakertown, Penna.
Raleigh Wyoming Mining Co., Glen Rogers, W. Va.
*Rhinelander Paper Company, Rhinelander, Wisc.
City of Richland Center, Wisconsin
*City of Richmond, Indiana
Sayles Biltmore Bleachery, Biltmore, N. C.
Scotten Dillon Company, Detroit, Michigan
Shelby Cotton Mills, Shelby, N. C.
Sloane-Blabon Corp., Philadelphia, Penna.
*Solvay Process Company, Detroit, Michigan
*St. Elizabeth's Hospital, Washington, D. C.
City of St. Bernard, Ohio
Swarthmore College, Swarthmore, Penna.
*Timken Roller Bearing Co., Canton, Ohio
Timken Roller Bearing Co., Gambrinus, Ohio
Municipal Water & Light Plant, Tippecanoe City, O.
City of Toledo, Ohio
*Union Bleachery, Greenville, S. C.
Union Mills Paper Mfg. Co., New Hope, Penna.
*University of Wisconsin, Madison, Wisc.
*Vassar College, Poughkeepsie, New York
Borough of Vineland, New Jersey
Warfield Natural Gas Company, Harold, Kentucky
White Sewing Machine Co., Cleveland, Ohio
Whiting Plover Paper Company, Stevens Point, Wisc.

(*) Represents repeat orders.

ARE YOU BUYING YOUR STOKER BY THESE TWELVE POINTS?

1. **RELIABILITY**—the ability to operate with minimum outage and minimum standby equipment.
2. **CAPACITY**—the ability to provide adequate prime capacity ratings, with sufficient reserve capacity for emergencies.
3. **MAINTENANCE**—the ability to operate continuously with minimum repair costs.
4. **FLEXIBILITY**—the ability to follow the steam demand upward or downward . . . quickly and without sacrificing efficiency.
5. **EFFICIENCY**—the proved dollar efficiency (total cost of steam production) as shown by actual performance in similar installations.
6. **OPERATION**—the ability to operate continuously, the number and type of operations required, the ease of combustion adjustments, etc.
7. **ADAPTABILITY**—the ability to meet special and limiting conditions, present and future—structural limitations, utilization of present equipment, growth and change of power service demands.
8. **FUEL FLEXIBILITY**—the ability to burn efficiently and easily fuels from many sources having widely varying characteristics.
9. **REFUSE DISPOSAL**—the ability to economically eliminate ash or refuse and the opportunities of disposal at low cost, no cost, or profit.
10. **STACK DISCHARGE**—the practical elimination of "smoke nuisance" without special equipment.
11. **SPACE REQUIREMENTS**—the ability to conform to existing or future space limitations, to short and wide or long and narrow furnaces. Also the accessibility of component parts for maintenance and operation.
12. **OBSOLESCENCE**—the adaptability of the equipment toward possible future modernization with minimum of complication and outage.

COMPANY

HOISTS, MARINE DECK AUXILIARIES

ARMSTRONG *Snap Action* AIR TRAPS

SOLUTION for many Compressed Air Troubles

MOISTURE and DIRT, two big sources of trouble in air operated equipment and compressed air systems, meet their match when you use Armstrong "Snap Action" Air Traps to drain air tanks, separators, after-coolers, and supply lines. By eliminating leaky drain valves and wasteful manual blowdown methods, these traps increase system capacity and produce very worthwhile power savings. Now is the time to get ready for the heavier condensate loads that come with warmer weather. Ask for complete information — interesting educational bulletin No. 143 on request.

ARMSTRONG MACHINE WORKS
810 Maple St. Three Rivers, Michigan

ADVANTAGES OFFERED:

1. **IMMUNITY TO ORDINARY DIRT TROUBLES.** Danger of dirt holding valve open is virtually eliminated by snap-action closing. Traps pay for themselves by reducing your maintenance expenses.

2. **OPERATE WITHOUT AIR LOSS.** Traps guard against excessive power costs. Water sealed valve.

3. **SELF-PRIMING.** The valve is closed when trap is dry. Never any fear about losing prime.

4. **POSITIVE ACTION.** Trap always goes through full operating cycle. Completely automatic.

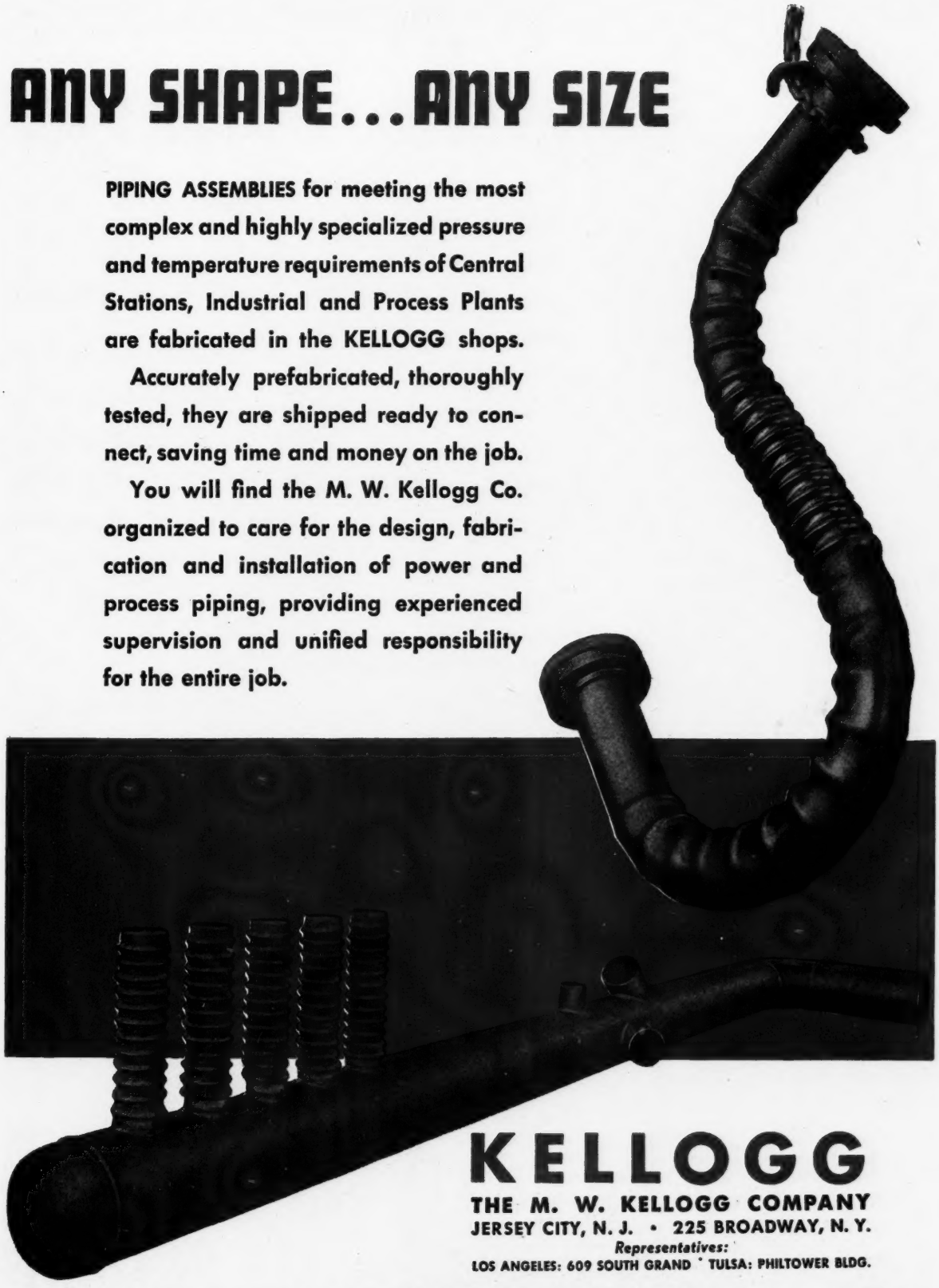
5. **LARGE CAPACITY.** Handles up to 1400 lbs. of water per hour at 125 lbs. pressure; 1000 at 250 lbs.

ANY SHAPE...ANY SIZE

PIPING ASSEMBLIES for meeting the most complex and highly specialized pressure and temperature requirements of Central Stations, Industrial and Process Plants are fabricated in the KELLOGG shops.

Accurately prefabricated, thoroughly tested, they are shipped ready to connect, saving time and money on the job.

You will find the M. W. Kellogg Co. organized to care for the design, fabrication and installation of power and process piping, providing experienced supervision and unified responsibility for the entire job.



KELLOGG

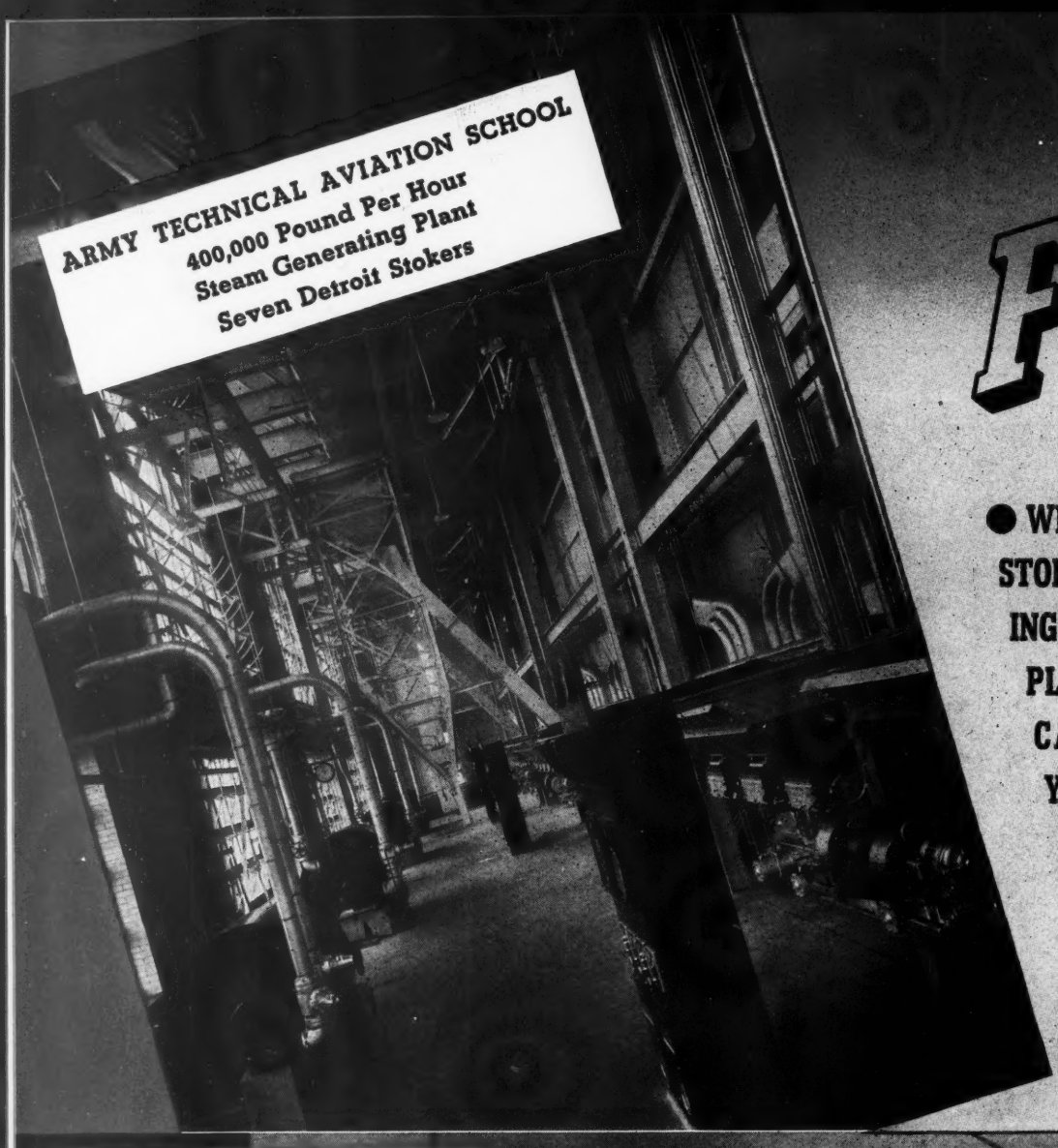
THE M. W. KELLOGG COMPANY

JERSEY CITY, N. J. • 225 BROADWAY, N. Y.

Representatives:

LOS ANGELES: 609 SOUTH GRAND • TULSA: PHILTOWER BLDG.

"Masterflex" Prefabricated Piping Systems • "Masterweld" pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic and Catalytic Cracking Units, Reforming, Dehydrogenation, Alkylation, Desulphurization, Thermal and Catalytic Polymerization Units JUIK Processes for Lubricating Oil Plants. Plastic Refractories • Radial Brick Chimneys.



ARMY TECHNICAL AVIATION SCHOOL
400,000 Pound Per Hour
Steam Generating Plant
Seven Detroit Stokers

FOR D

● WHAT DETROIT STOKERS ARE DOING FOR DEFENSE PLANTS—THEY CAN DO FOR YOU. INVESTIGATE NOW.

LARGE SHIPBUILDING PLANT
300,000 Pound Per Hour Plant
Six Detroit Stokers

DETROIT ROTOSTOKER

DETROIT FOR DEFENSE

DEFENSE PLANTS

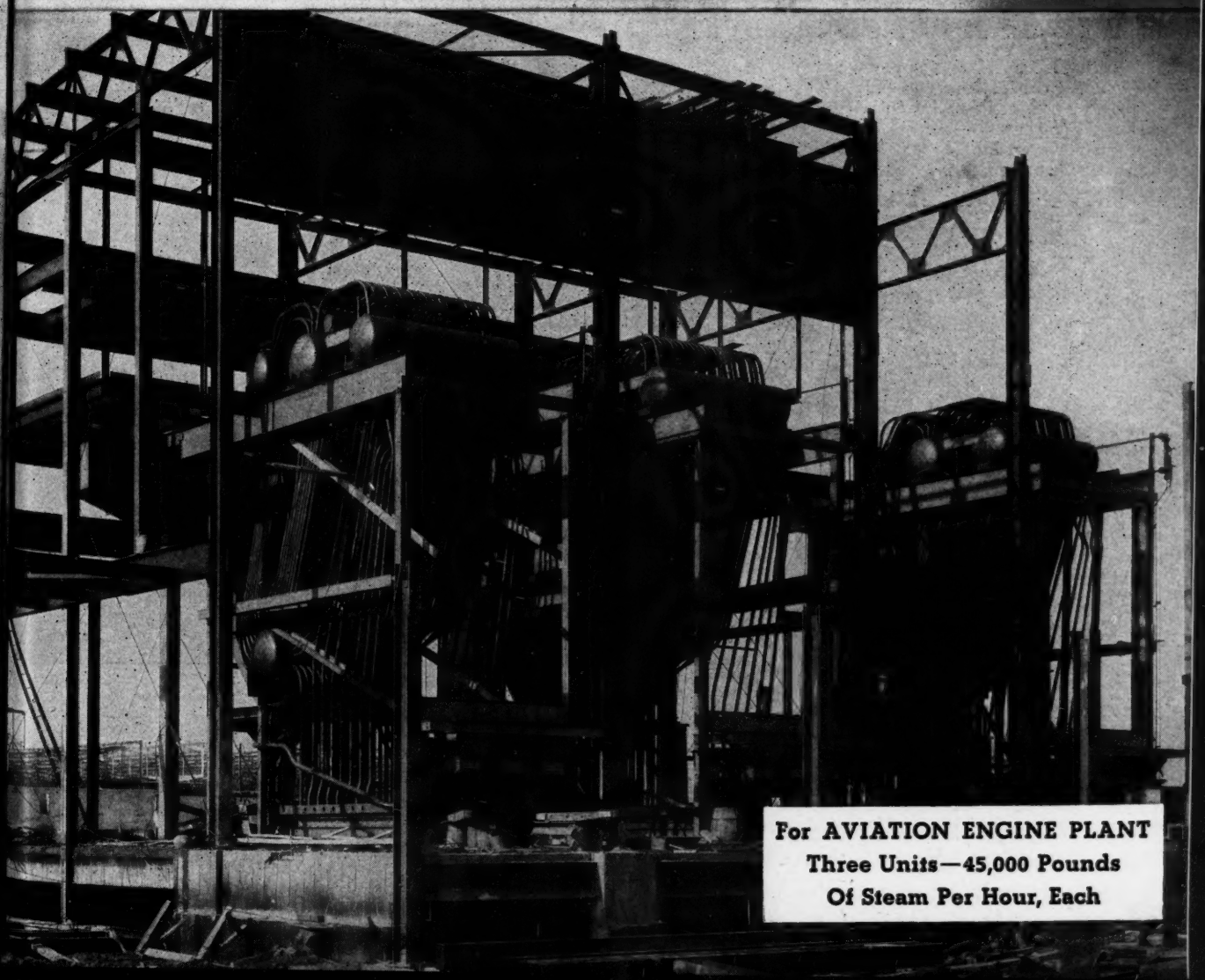
DETROIT STOKERS

Doing their part—by saving coal and labor. • Selected for many prominent plants engaged in DEFENSE WORK. • Let us send you a CATALOG, illustrating the various types of DETROIT STOKERS. • No obligation—write for No. 824.

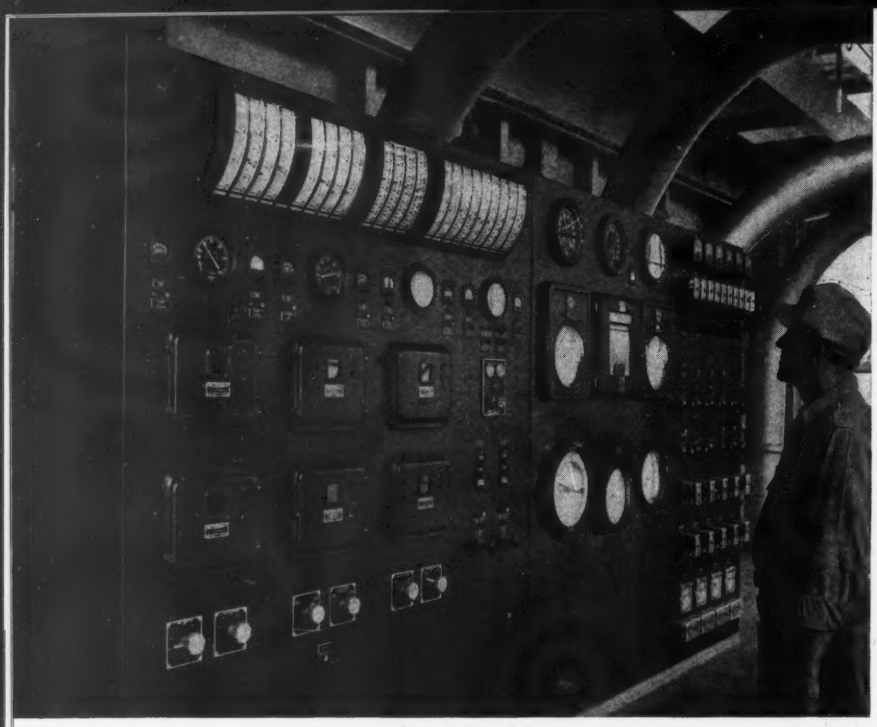
DETROIT STOKER COMPANY

FIFTH FLOOR, GENERAL MOTORS BUILDING, DETROIT, MICHIGAN

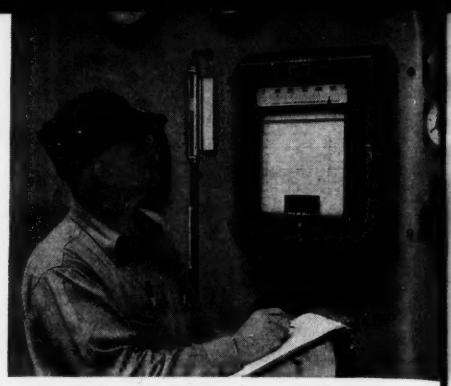
Main Office and Works—Monroe, Michigan



For AVIATION ENGINE PLANT
Three Units—45,000 Pounds Of Steam Per Hour, Each



Metermax Combustion Controllers in Use



Micromax Flowmeter Recorder Showing Flow to Turbine

If Your Load Has A Wartime Swing, Here's How L&N Can Help You

In the boiler and turbine rooms are a whole group of operating problems which we can possibly help you handle. If some of your men are in uniform, or your power load has a wartime swing, perhaps the following are needed:

Control of Combustion. Metermax instruments handle any problem, whether simple or complex, for any plant from a few hundred horsepower to the biggest private or public-utility plant. Particularly, you'll like micro-responsiveness, dependability, and set-it-and-forget-it qualities. See Catalog N-01-163.

Temperature Records. 24-hour strip-charts which fit a letter file, and record in as many as 6 colors, are available from Micromax Temperature Recorders. See Catalog N-33-163 for steam-end uses, and N-33-161 for electric ones.

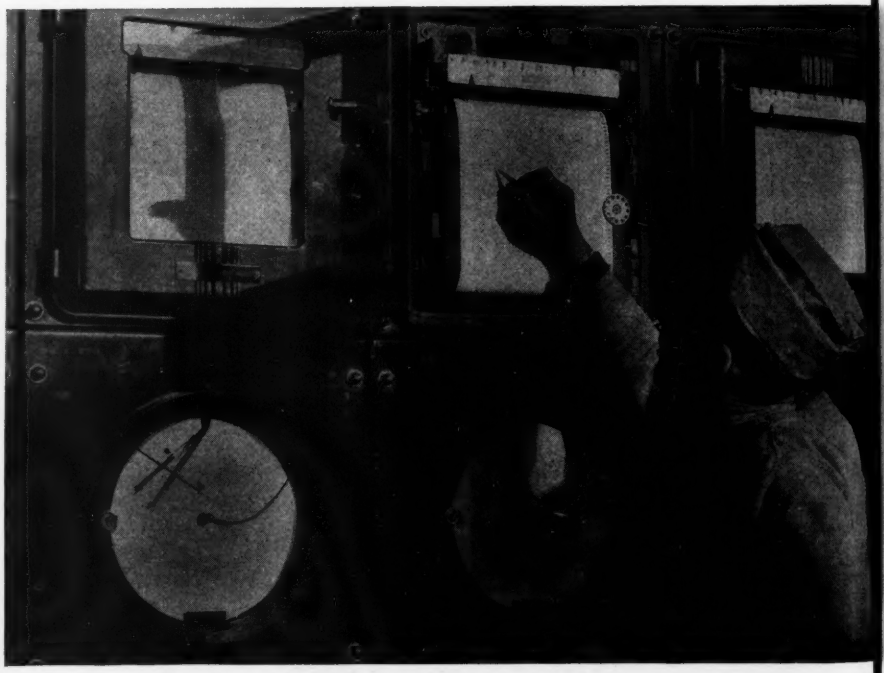
Control of Superheat. If you're installing a new boiler, here's a comparatively new Micromax Control which saves a lot of power. Details in Catalog N-33-163(1), sent on request.

Record of CO_2. A Micromax CO_2 Recorder is as dependable as a pyrometer, and almost as simple. Characteristics are sensitivity and *quick* response; explained in Catalog N-91-163.

Smoke Density Recording. A smoke problem is easier to handle if your men have an easy-to-read Micromax Smoke Recorder, and you have the instrument's charts of actual conditions. See Catalog N-93-163.

Flow Measurement. We can't help you if the usual accuracy is all you want in flow measurement. But if you need something like lab accuracy in an industrial flowmeter, call in our Centrimax. Or see Catalog N-28-160.

Satisfactory Boiler-Feed Water. Automatic records of the conductivity of condensate, or of the pH of feedwater, or of both, are available through Micromax equipments. Catalogs on request.



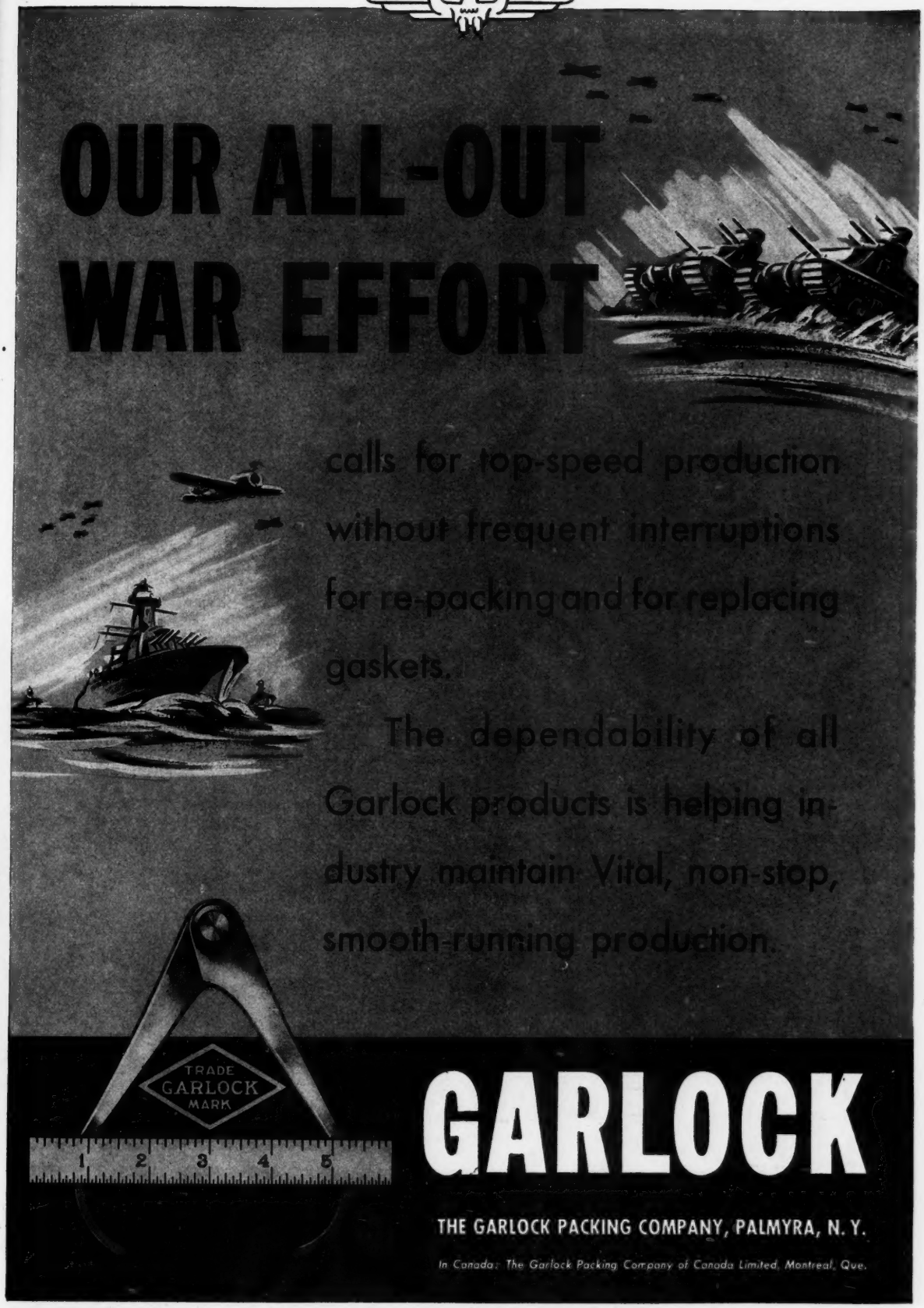
Micromax Conductivity Recorders in a Cotton Mill Power Plant

Jrl Ad N-163(8)

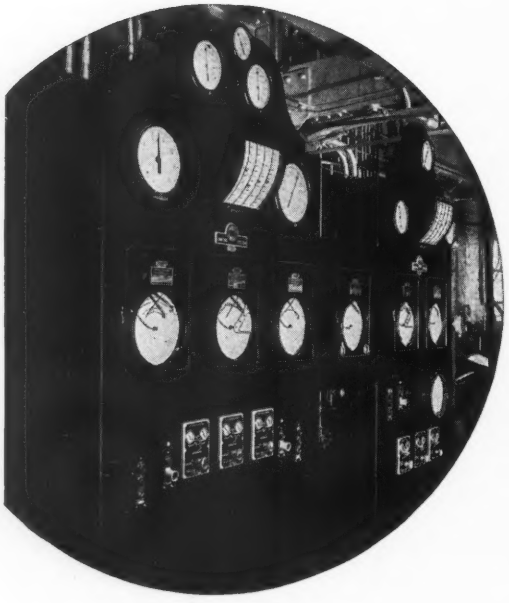
LEEDS & NORTHRUP COMPANY, 4973 STENTON AVE., PHILA., PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES


OUR ALL-OUT WAR EFFORT
calls for top-speed production without frequent interruptions for re-packing and for replacing gaskets.
The dependability of all Garlock products is helping industry maintain Vital, non-stop, smooth-running production.
TRADE GARLOCK MARK
1 2 3 4 5
GARLOCK
THE GARLOCK PACKING COMPANY, PALMYRA, N. Y.
In Canada: The Garlock Packing Company of Canada Limited, Montreal, Que.

ARMS FOR THE BATTLE OF PRODUCTION



★ This is a mechanized war. Battles are being won by hard-fighting men who are well armed with modern equipment.

In the battle of production the boiler operator whose effectiveness is multiplied by Bailey Meters and Control is like the machine gunner who rides to battle in a jeep, tank or airplane. Both men are better able to serve because they use modern arms.

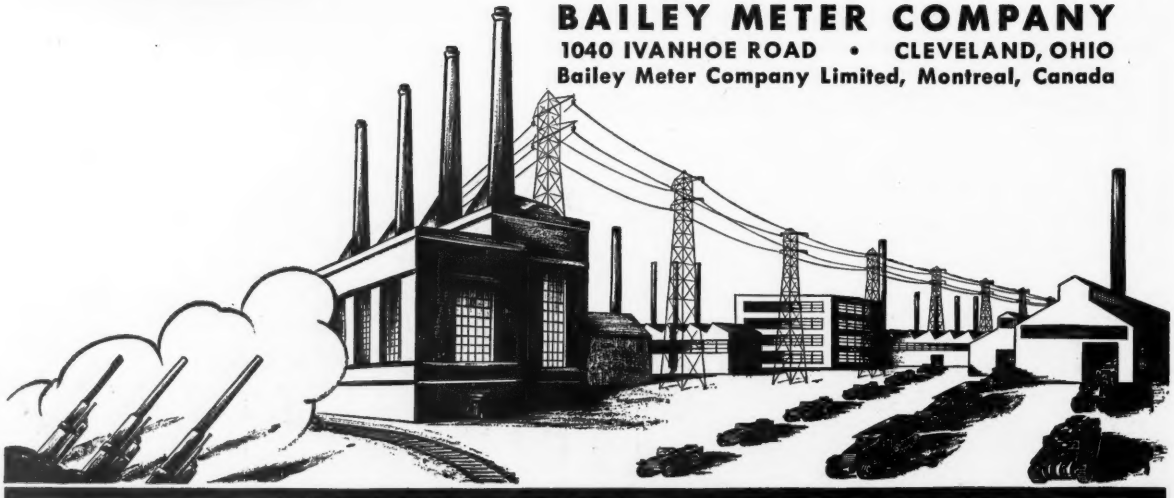
To win the battle of production, boilers must be kept in almost continuous service, maximum capacities must be secured, fuel must be conserved, men and equipment must be protected against accidents, and new manpower must be trained.

Bailey Meters and Control are helping to win this battle. They are modern arms for boiler room soldiers. By their use power engineers are able to:

1. Avoid frequent shutdowns for maintenance.
2. Stretch steaming capacity.
3. Reduce consumption of fuel.
4. Insure safety of men and equipment.
5. Maintain efficiency while training new operators.

Their use is explained in the bulletin "How to Safely Stretch Steaming Capacity", which offers suggestions for the solution of many of today's problems. To obtain a copy simply ask for Bulletin No. 16. A-84-1

BAILEY METER COMPANY
1040 IVANHOE ROAD • CLEVELAND, OHIO
Bailey Meter Company Limited, Montreal, Canada



BAILEY METER CONTROL

The Complete Combustion Control System

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHEAT CONTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

New Pump ... offers 5 big Improvements!

New Allis-Chalmers Electrifugal "One Package" Pump is 5-Way Winner in Helping You Meet Wartime Industrial Pumping Needs!

NEW in design . . . NEW in construction — Allis-Chalmers Electrifugal Pumps give you a NEW type of pumping performance . . . to meet the most exacting requirements of war industry.

With this compact, sturdily-mounted pump-and-motor unit, you save up to 33% in space, reduce pump overhang as much as 40%. Unified "Tri-fit" construction, too, results in fewer section fits, fewer parts to wear, more positive shaft alignment. All this means smoother-running, longer-lasting, vibration-free operation.

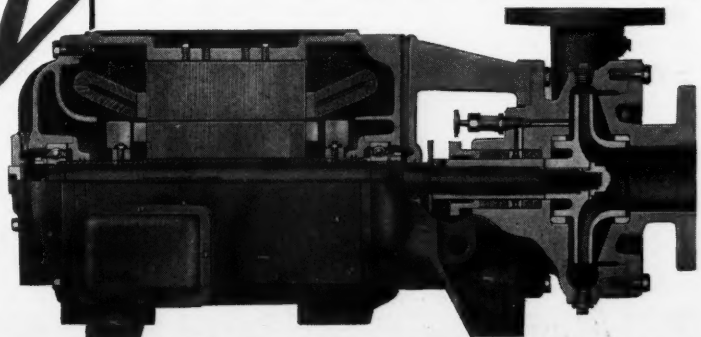
Too — the motor is new . . . 100% designed for pump use . . . and completely splash-proof. Cast bronze protective sleeves, easy-to-get-at casing, indestructible rotor, distortionless stator are other features you'll like.

So — if it's pumps you need . . . and if you want to get better pumping with as much as 33% saving in initial costs over conventional pump installations — use this 5-way winner . . . in sizes from ½ hp to 25 hp.

For the whole story, call the district office near you. Or write Allis-Chalmers, Milwaukee, Wisconsin. A 1495

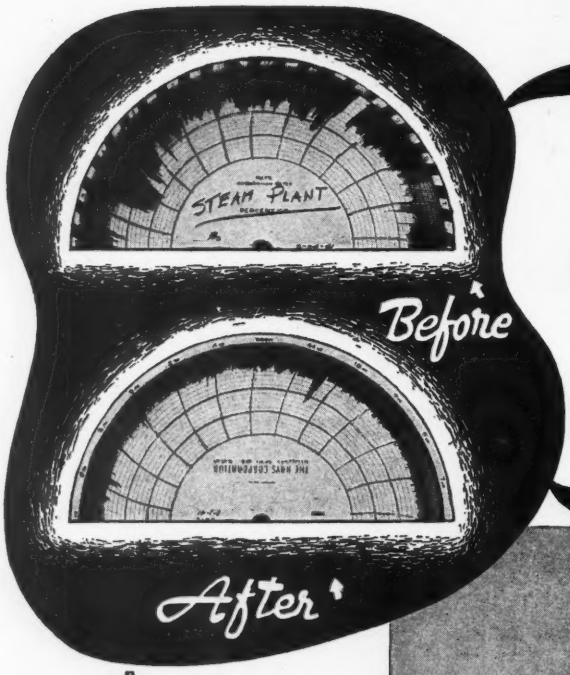
CHECK These Great One-Package Features:

1. *Up to 33% Space Saved* with one frame, one solid driving shaft construction.
2. *Overhang Cut As Much as 40%.* Four solid supports assure precision balance . . . ease strain on vital parts.
3. *New Tri-Fit Design* eliminates 2 section fits for more positive shaft alignment, wearless and vibration-free performance.
4. *Splash-Proof* Motor standard equipment . . . 100% designed for pumping.
5. *Easy-to-Get-at* Casing simplifies stuffing box and waterseal gland inspection.



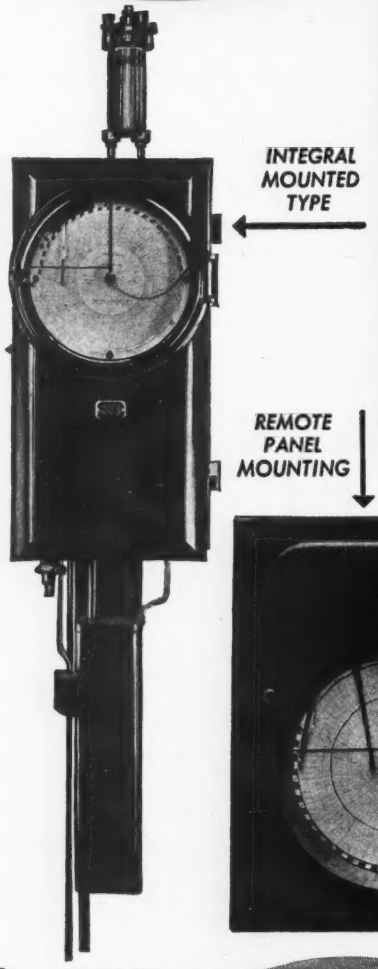
Allis-Chalmers Pumps Can Cut Your Pumping Costs

ALLIS-CHALMERS
MILWAUKEE · WISCONSIN



HOW HAYS COMBUSTION METER *Improves Boiler Operation*

THE two segments of charts shown above, taken from a Hays Combustion Meter installed in a north west paper mill tell a graphic and convincing story. Upper chart shows the low and erratic CO_2 the first day of operation, typical of the wasteful method of firing before installation of meter. Lower chart shows results exactly one week later, after the meter had taught the operators how to fire the boiler properly—fuel saved, smoke eliminated, more heat secured, steam pressure more constant.



Send FOR THIS HANDSOME NEW BOOK

It contains complete information on CO_2 —its significance and measurement. It's FREE.

The HAYS CORPORATION
COMBUSTION INSTRUMENTS AND CONTROL
MICHIGAN CITY, INDIANA, U.S.A.

WHEN LOADS REACH PLANT CAPACITY

HERE'S HOW NONPAREIL CAN HELP

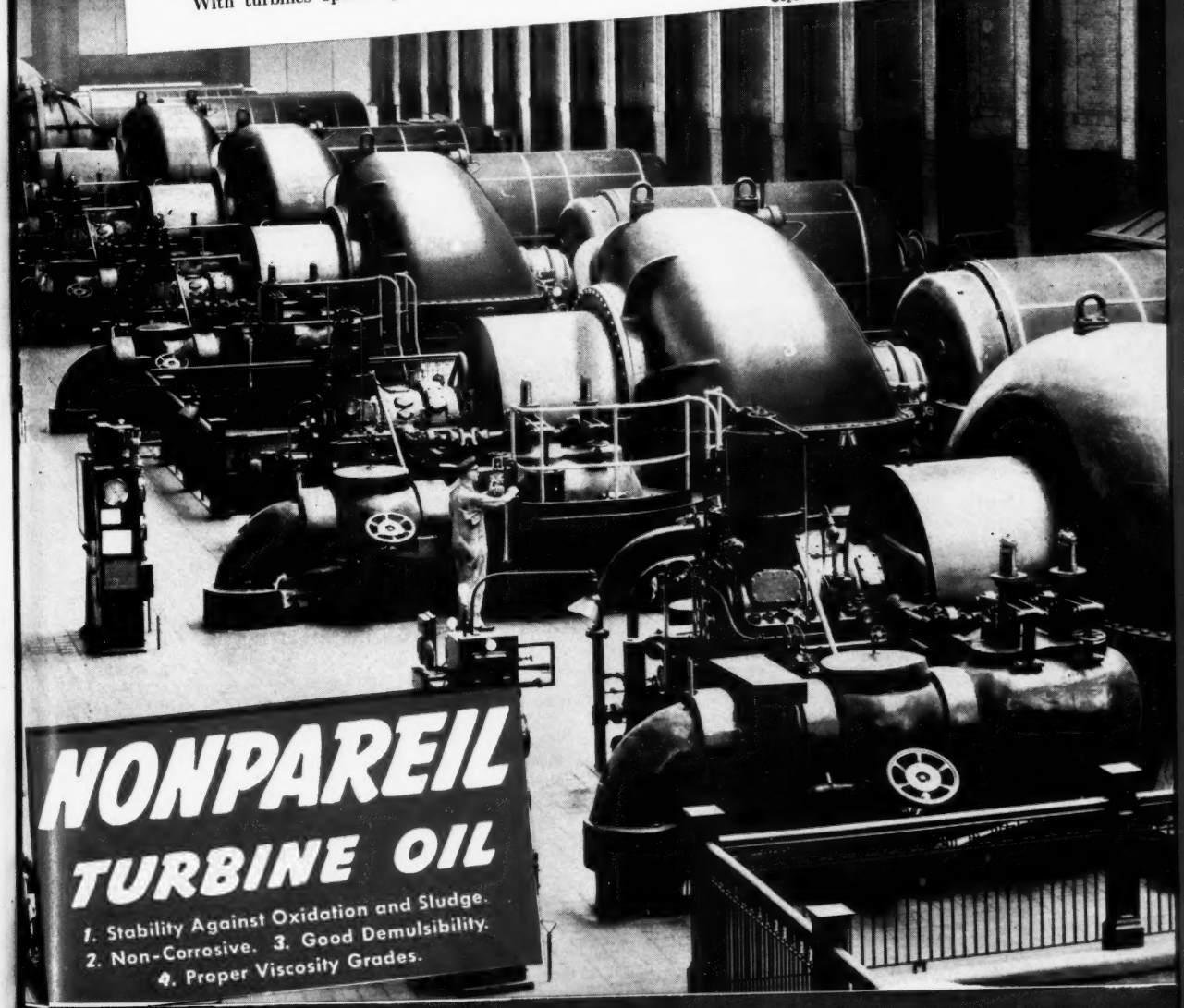
● Is THE TIME NEAR when every minute of turbine operation will be needed to meet your power demands? If so, it's time to find out how Nonpareil Turbine Oil can help meet these additional requirements.

Since Nonpareil remains extremely low in acidity, troublesome emulsions are avoided. Since Nonpareil forms no sludge, periodic cleaning of oil lines and tanks is eliminated. These qualities save many man-hours of labor even though this work has been done in the past at the time of regular overhauling.

With turbines operating continuously, the demands on your turbine oil will be much more exacting. Cleaning oil systems, treating or replacing oil must be done more frequently. These may even cause serious outages. They can be avoided with Nonpareil. It is guaranteed to last as long as your turbine.

Let a Standard Lubrication Engineer explain to you or your operating men how Nonpareil can help you in many ways during this emergency. Write Standard Oil Company (Indiana), 910 S. Michigan Ave., Chicago, Ill., for the Engineer nearest you. In Nebraska, write Standard Oil Company of Nebraska at Omaha.

Copr. 1942, Standard Oil Company



NONPAREIL TURBINE OIL

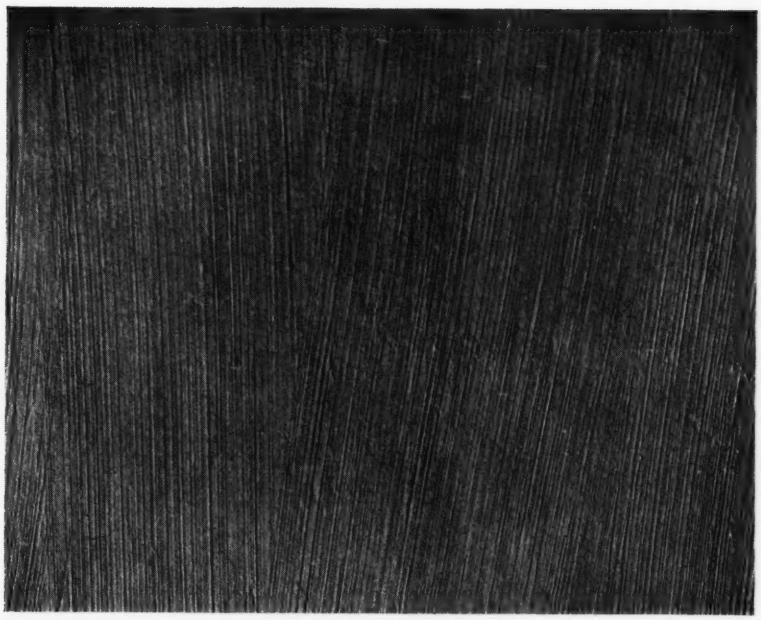
1. Stability Against Oxidation and Sludge.
2. Non-Corrosive. 3. Good Demulsibility.
4. Proper Viscosity Grades.

STANDARD OIL COMPANY (INDIANA)

LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION E

...LUBRICATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICATION ENGINEERING

Re-Surfaced — Made Good as New



APEXIORIZED Boiler Metal

APEXIOR Protection Renews Old-Boiler Life

These days there's no argument about renewing all wearable materials for longer service. More so with steam boiler and turbine equipment — new installations don't come with a phone call. Your boiler metal positively must stand wear and tear for — who knows how long?

Old boilers — even those approaching the junk-heap — can be kept in indefinite service when protected with APEXIOR. Clean the metal down, and if the required hydrostatic pressure can be withstood, APEXIORIZE; and the equipment will be good for years of service.

APEXIOR — a Durable New Surface that Takes the Wear

APEXIOR No. 1, applied with a hand brush or power coater, adds an impervious top skin to boiler metal. This guardian "armor" resists wear, shuts out corrosion's penetration, prevents tight bonding of any scale that forms. Simple wire-brush cleaning removes the loosely adherent scale — with little down-time loss.

Easily renewed, an APEXIOR surface lasts up to three years or more.

APEXIOR guarantees good metal condition — no other protection offers the same assurance and security

As a supplementary protection with feedwater treatment, APEXIOR has been known and used for many years by power engineers who insist on peak efficiency and good housekeeping.

Now it means more than that — an *essential* in the serious business of prolonging and assuring efficient operation of old and new tubes and drums.

It will be worth dollars, time, production to you to investigate APEXIOR.

Write for Bulletin 1290

APEXIOR REG U.S. PAT. OFF.

Recommended by all U. S. and Canadian boiler companies

THE DAMPNEY COMPANY OF AMERICA

PROTECTIVE COATINGS FOR STATIONARY BOILERS, LOCOMOTIVES AND STEAMSHIPS

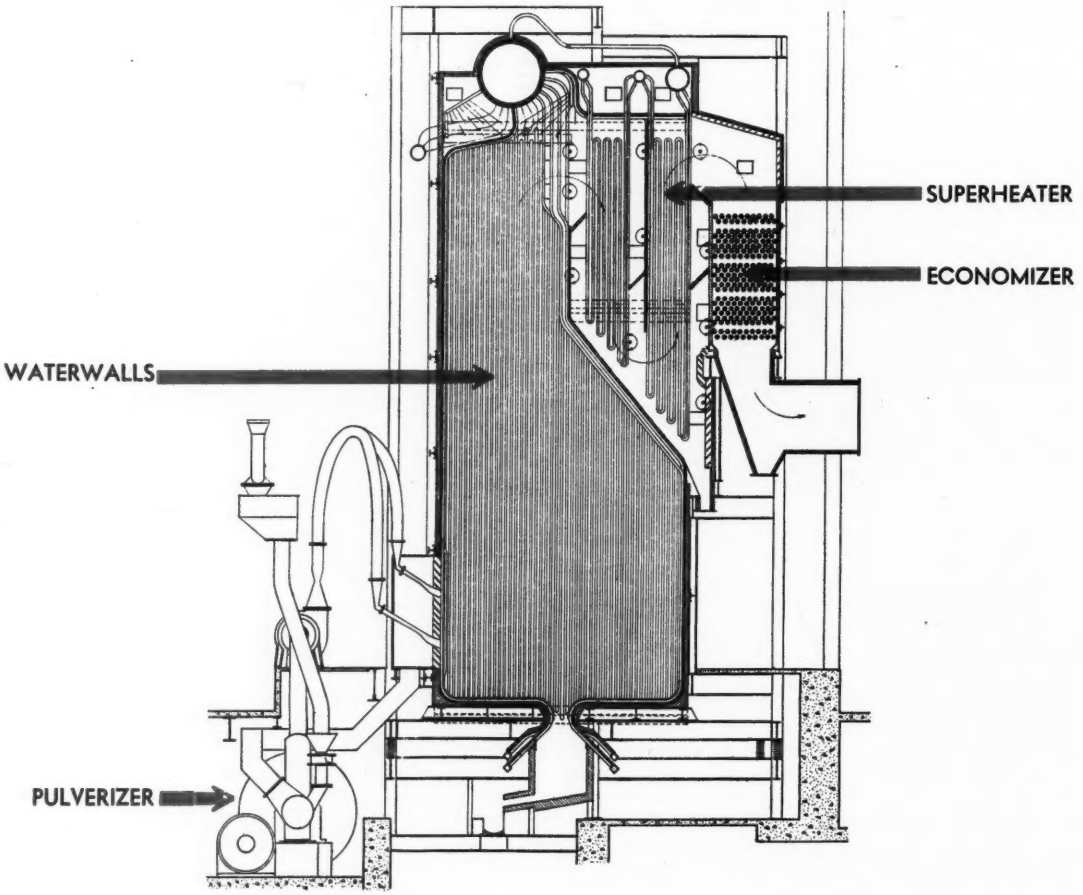
HYDE PARK · BOSTON · MASSACHUSETTS

Atlanta Chicago New York Detroit Philadelphia

Engineering Sales Representatives — Pittsburgh, Cincinnati, New Orleans, San Francisco, Los Angeles, Portland, Seattle, Phoenix, Denver, Salt Lake City, Dallas, Houston, Vancouver, B. C., Montreal, P. Q., Havana, Cuba, Manila, P. I., Honolulu, T. H., Marine Dept., 114 Liberty Street, New York, N. Y.

WHAT IS THIS

COLUMBUS AND SOUTHERN OHIO ELECTRIC CO.
WALNUT STREET STATION



Maximum Load: 325,000 lb. steam per hour, 1400 lb. per sq. in. pressure, 900° F. final steam temperature

Foster Wheeler Corporation,

FOSTER

BOILER RATING?

The heating surface of this modern steam generator* is comprised of the following heat absorbing areas:

	Per cent of total heating surface
Superheater	42.6
Economizer	37.2
Waterwalls	20.2
BOILER TUBES	0

For 44 years Foster Wheeler has pioneered in the development of pulverized fuel systems and the three heat absorbing surfaces essential for modern central station steam generating units.

1898 **Pulverized fuel** developed on a commercially successful scale.

1904 **Superheaters**—introduced the commercial use of superheated steam in the United States.

1919 **Economizers** — introduced the forced circulation, high draft loss, counter-current, unit economizer.

1923 **Water cooled walls** for many types of furnaces burning various fuels.

*Exclusive of regenerative air heater.

165 Broadway, New York, N. Y.

WHEELER

What caused the failure of this superheater tube?

DETAILS OF TUBE FAILURE: Tube evenly thin all around—thickness at bend approximately .076", as against .155" in straight section. Only one tube failed. No burning on furnace side except at localized failure. No furrowing or pitting on inside surface—no distortion—adherent scale paper-thin.

EXTERIOR BURNING?
CARRYOVER?
DEFECTIVE TUBE?
WATER CONDITIONING?

Here's how the answer was found...

CHEMICAL ANALYSIS: Main constituents of scale: magnetic iron oxide 63.5%, calcium oxide 21.1%, minor constituents: magnesium oxide 2.1%, silica 0.3%, carbon dioxide 2.8%; no evidence of phosphate.

ON the basis of the evidence presented, what *actually* caused the trouble?

Exterior Burning? No – because no other tubes showed any effect of localized high temperature, thinning was relatively even all around the failed tube, and the failure was very localized.

Carryover? No—because alkaline boiler water concentrating in a superheater develops high causticity and results in furrowing and pitting, not in *even* thinning. Furthermore, the quantity of bright magnetite crystals deposited by carryover is large—much larger than the very thin coating found in this case.

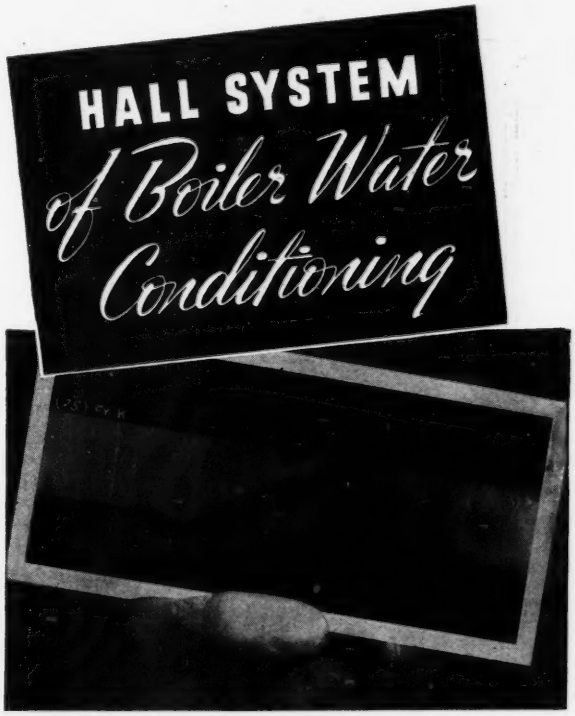
Water Conditioning? No – because no calcium phosphate was present. The thin deposit consisted mainly of magnetite and calcium hydroxide – caused by evaporation of treated water used for filling the superheater when the boiler was off the line.

Defective Tube? Yes! Thinness did not develop during operation, as proved by the even thickness of the tube circumference, by lack of distortion from round, and by uniform inside tube-diameter. Thinness developed in the drawing and bending of the tube. The defective condition was original—not caused by the incidents of operation.

• • •

It may seem unusual for Hall Laboratories to search so carefully into the cause of such a relatively simple problem. But when the Hall report on *your* boiler problem arrives, you may be sure that *every* clue has been thoroughly investigated. That is why so many Hall System plants operate continuously *without* unscheduled outages – for years and years and years.

MICROSCOPIC EXAMINATION: Deposit analyzed principally as "black opaque octahedra of magnetite, with some blood-red transparent crystals of hematite and small amounts of calcite." Identification of other constituents rendered difficult by opacity of magnetite.



X-RAY ANALYSIS: Opacity is no screen for penetrating X-rays. Diffraction lines on X-ray film showed "finger prints" of magnetite and calcium hydroxide—no significant amount of any other crystalline constituent.

HALL LABORATORIES, INC. · 300 ROSS STREET · PITTSBURGH, PA.

MORE POWER

MURRAY CONTRIBUTIONS TO AMERICA'S DEFENSE

Boilers
★
Turbo-Generators
★
Mechanical Drive Turbines
★
Unit Heaters
★
Gears

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

Business with Murray is not "as usual." Much of our engineering skill and production facilities now are being centered on designing and building power equipment for America's vital defense industries.

Among Murray's outstanding contributions to national defense are the driving turbines on the compressors for the largest industrial air conditioning installation made in America, a 7000 HP. job for a large builder of airplane engines . . . the turbo-generators for one of the largest Ordnance Plants . . . and large quantities of equipment for Navy, Army and Maritime installations.

Although "defense orders must come first," Murray will continue to cooperate with and meet the power equipment demands of civil industries as far as it is humanly possible.

MURRAY IRON WORKS COMPANY • BURLINGTON, IOWA

MURRAY

DON'T TAKE CHANCES ON RUST

YOU NEVER KNOW when rust will stop your turbines. And right now is no time to take a chance. Lubricate with the new tested and proved Shell Turbo Oil, the turbine oil that meets all *three* requirements of modern turbine lubrication . . .

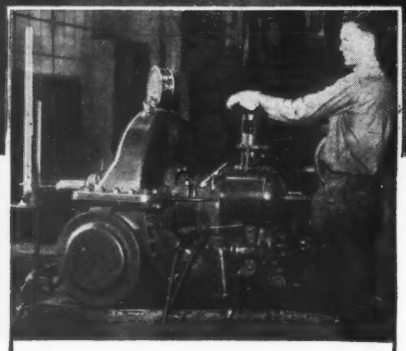
RUST PREVENTION
SUPERIOR OXIDATION STABILITY
MINIMUM FOAMING TENDENCY

There's no reason for you to accept less. Call in Shell now!

SHELL

Guard YOUR turbines with New RUST-PREVENTIVE SHELL TURBO OIL

We Take the "BLOOD PRESSURE" of G-E Turbines



Even the smaller Type D mechanical-drive turbines are given a complete operating test under steam to provide advance proof of their performance. This running trial permits adjustment of the speed governor, setting of the overspeed trip, checking smoothness of rotation, and testing packing glands and steam joints. It's attention to these details that reduces the time from shipping crate to machine in operation.

TAKING the "blood pressure" of a new multistage turbine sounds fairly simple. It is—if you have enough room, men, steam, equipment, and time. First, you set up the turbine just as it will be installed in service and make all steam and oil connections. Then you attach more than a score of manometers, thermocouples, and gages; and load up the turbine with a water brake. It takes 14 men to do the job accurately, because inlet pressure, speed, brake force, and exhaust pressure must be held steady while simultaneous readings are taken.

When you finish you have pages of test data that the engineers in the Steam Design Section translate in terms of nozzle, bucket, and turbine efficiencies. Each reading and curve gives valuable knowledge of the design under test.

This is just one of the many tests that are being made continually in G-E turbine workshops—tests that assure utilities, industrials, and ourselves that a turbine-generator with the G-E nameplate will deliver the performance for which it was designed. What's more, these tests are always adding to the fund of knowledge that has enabled G-E engineers to build more reliable, more efficient turbines year after year.

General Electric and its employees are proud of the Navy award of Excellence made to its Erie Works for the manufacture of naval ordnance.

2500-kw, 60-cycle turbine-generator installed in 1928

In 12 Years of Unfailing Operation

95,513,050 Kw-hr Generated — $535 for Two Routine Inspections

TROUBLE took a holiday for 12 years in a Kansas power plant—thanks to a 2500-kw G-E turbine generator. The unit was installed in 1928 to generate low-cost, dependable power. Twelve years later, when a new 4000-kw G-E turbine took over the load, the log book told a performance story of economical, reliable operation—95,513,050 kw-hr generated; only $535 spent for maintenance. The inspection record indicated that the only renewal parts necessary were a supply of slip-ring brushes, one ring of steam-seal carbon packing, and seats for the pressure control valve on the auxiliary oil pump. "The turbine never failed to perform its duty as the main generating unit in our plant," said Supt. W. O. Meyers, "and we are expecting equally as good service from the new 4000-kw unit."

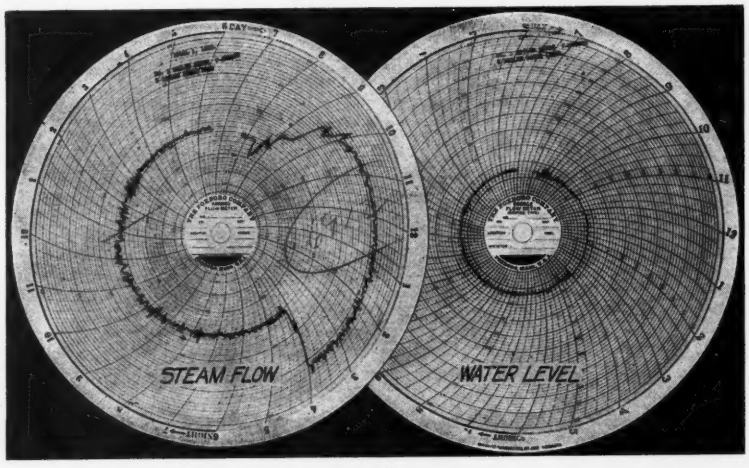
General Electric turbine-generators are noted for their superb performance and long life. Right now, when power-hungry industry is putting the problem of producing more power squarely up to you, and the delivery of new units is being made only to war-production plants, trouble-free performance is doubly important.

In these days it is especially desirable that a periodic schedule of inspection and maintenance be followed. When assistance is needed, we urge you to take advantage of our field service. Your nearest G-E office will help you make sure you are getting the most out of every G-E machine in your plant. ***General Electric, Schenectady, New York.***

GENERAL ELECTRIC

600 POUNDS W. S. P.

Firing with acid sludge or gas normal evaporation is as high as 350,000 lb. per hr. on this 600-lb. pressure Riley Steam Generator. Water level is carried one inch higher at 360,000 lb. per hr. peak load than at normal minimum of 242,000 lb. per hr. Level control by COPES Flowmatic is unusually close on all loads.



★ *Unaffected by drafts or changes in temperature—even outdoors*

CENSORED

We can't tell you the name of this company or the location of its plants—not until the war is won—because it is in the vanguard of those producing for victory. But we can show you, by repeat orders, how this company depends on COPES Flowmatic for close boiler water level control, in spite of rapidly changing loads.

The first two Flowmatics were installed on a 600-pound Riley unit, capacity 350,000 pounds an hour, in 1937. Since then, six repeat orders have been placed by this important user:

Date	No.	Boiler	WSP Lb.	Cap. Lb./Hr.
1940	1*	Riley	620	350,000
1941	4	C-E	175	140,000
	1	Kellogg	390	72,000
	1*	C-E	620	300,000
1942	1	C-E	620	300,000
	1	Riley	400	60,000

*Two COPES Flowmatic Regulators installed on each boiler.

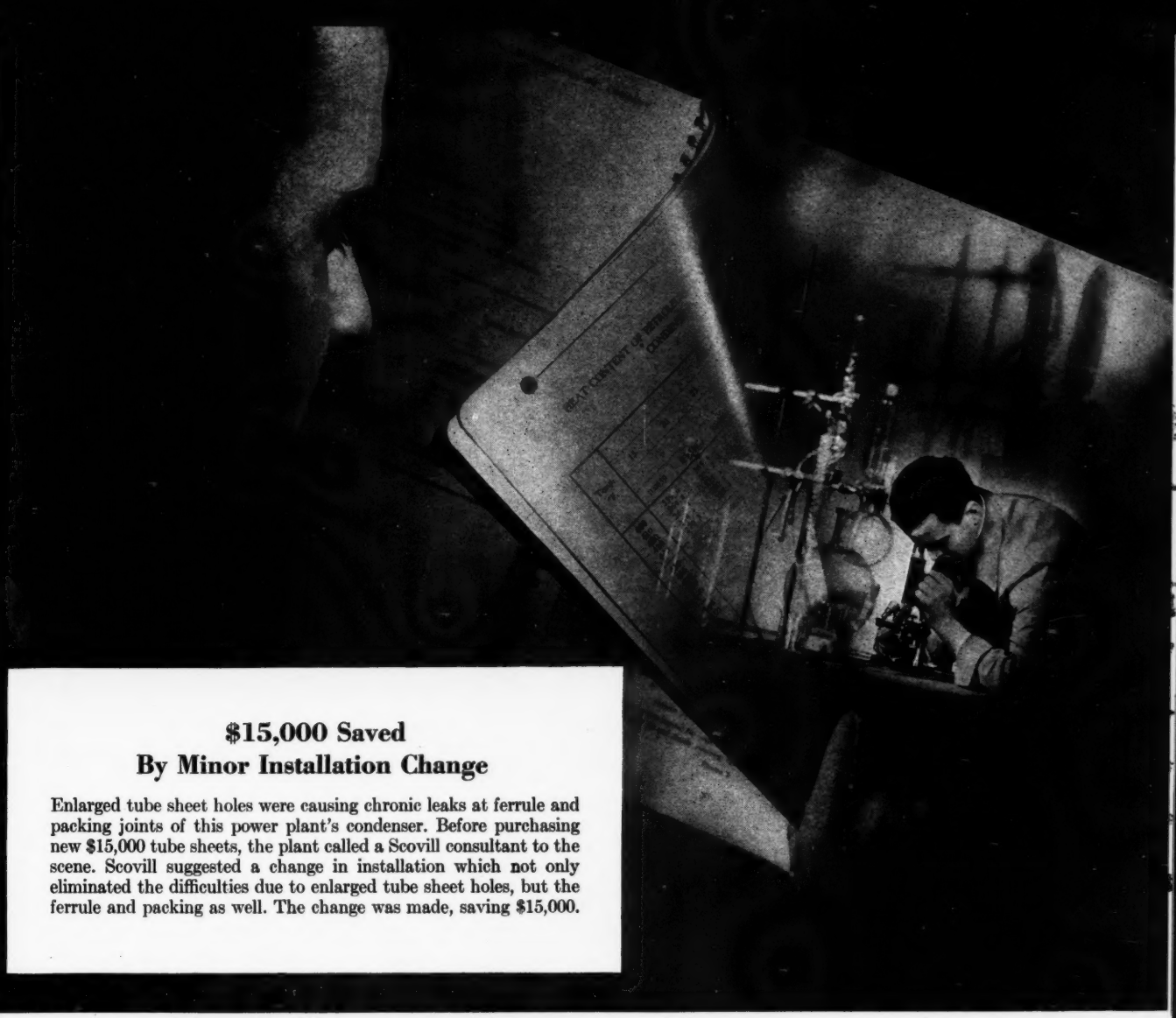
EXPERIENCE shows that changes in atmospheric temperature have no effect on the dependably accurate performance of the COPES Flowmatic Regulator. This installation, for example, is all outdoors and temperature changes of 80 degrees F. have not interfered with correct feed regulation or water level control. Nor has there been need for factory service. This Flowmatic, cut into service and accurately adjusted by plant personnel, has worked well for more than four years with only routine inspection and care. Write for Bulletin 429 describing the simplified two-element steam-flow type COPES Flowmatic Regulator.

NORTHERN EQUIPMENT CO., 522 GROVE DRIVE, ERIE, PA.

Feed Water Regulators, Pump Governors, Differential Valves
Liquid Level Controls, Reducing Valves and Desuperheaters

BRANCH PLANTS IN CANADA, ENGLAND REPRESENTATIVES EVERYWHERE

★ GET CLOSER LEVEL CONTROL WITH THE FLOWMATIC



$15,000 Saved
By Minor Installation Change

Enlarged tube sheet holes were causing chronic leaks at ferrule and packing joints of this power plant's condenser. Before purchasing new $15,000 tube sheets, the plant called a Scovill consultant to the scene. Scovill suggested a change in installation which not only eliminated the difficulties due to enlarged tube sheet holes, but the ferrule and packing as well. The change was made, saving $15,000.

Use the laboratory behind the page

. . . To Make Scarce Metals Serve You Better and Longer

"At 210° F., recommend 70-30 Cupro-Nickel" . . . said Scovill's laboratory technicians, solving a complicated heat exchanger problem for a Scovill customer. You too may find that Scovill's laboratories can help you find the right tube for the job, or make the tubes you have stay on the job longer.

Scovill's new Heat Exchanger Tube Manual well illustrates the wide scope of Scovill's Service to Condenser Tube users. When any special problem in metal arises, whether it be the selection of materials to resist corrosion . . . or an expert analysis of your conditions of heat transfer or fluid flow . . . use *the laboratory behind the page* for time-and-money-saving results.

The new edition of the "Manual" includes charts, formulae, specifications and technical discussions — all on subjects of interest to those engineers and associates who are constantly needing unusual practical data to help them solve their heat exchanger and condenser tube problems.

Another publication — "Scovill Condenser Tubes" — is available to others whose heat exchanger tube problems are concerned with the more common problems of corrosion, material selection and methods of installation.

And yet these two publications represent only one of Scovill's three services for power, marine, and refinery engineers. Scovill's service in Manuals is supplemented by Scovill's field service in men, and Scovill's laboratory service in metals. Write to Scovill Manufacturing Co., 17 Mill Street, Waterbury, Connecticut.

★ ★ ★ ★ ★ ★ ★

Scovill, for many years a regular source of supply for the U. S. Government, is cooperating in every way to forward defense plans. When deliveries are not as prompt as our customers desire, we hope they will realize that delays are sometimes unavoidable, and part of the price paid for National Defense.

SCOVILL
Masters of Metal

Scovill Condenser Tubes

ONE PRODUCT...THREE SERVICES

- **SERVICE IN MEN**
- **SERVICE IN METALS**
- **SERVICE IN MANUALS**

Data on Properties and Working of Free-Machining "KR" Monel

A strong, corrosion-resistant alloy suitable for machining parts which may be hardened by thermal treatment

The new INCO Nickel Alloy, "KR" Monel,* possesses the same combination of properties as "K" Monel.* Equally rustless and resistant to corrosion, it can be hardened by the same treatment to obtain the range of strength, ductility and hardness shown in table below. Like "K" Monel, this alloy is also non-magnetic. However, its machining characteristics are much superior to those of "K" Monel.

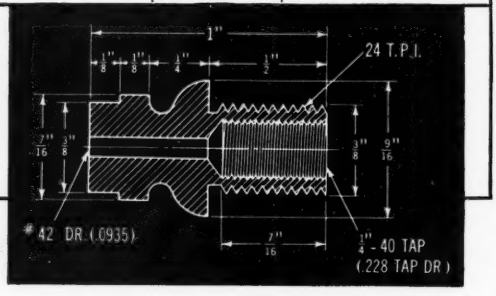
Machining data appear in the sketch and work sheet of operations on a practical job. For more detailed instructions, send for the new, revised edition of Bulletin T-12, "Machining Monel, Nickel and Inconel." Address:

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York, N. Y.

TABLE OF OPERATIONS

Operation	Rev. Per Min. Spindle	Rev. Per Min. Attachment	Surface Ft. Per Min.	Feed Inches	Remarks
Form	560	....	82	.00025	.....
Box Tool	560	....	82	.003	.....
No. 1 Drill	890	....	54	.002	L.H. Drill
No. 42 Drill	890	1600	60	.0015	L.H. Drill Drilling Attachment
Thread	560	308	25	.0416	Threading Attachment
Tap	560	183	25	.025	Tapping Attachment
Cut Off	560	....	82	.0002	.....

Material—9/16" dia. cold drawn as drawn (not age hardened) "KR" Monel
Machine—No. 2 B & S Automatic Screw Machine
Forward speed of spindle—560 R.P.M.
Backward speed of spindle—890 R.P.M.
Tool—high speed steel (18-4-1 Type)
Cutting lubricant—sulfurized oil



"Monel" and other trade-marks which have an asterisk associated with them are trade-marks of The International Nickel Company, Inc.

MECHANICAL PROPERTIES OF "KR" MONEL

Rods and Bars—Cold Drawn	Tensile Strength 1000 p.s.i.	Yield Strength (0.20% Offset) 1000 p.s.i.	Elongation in 2 in. per cent	Brinell Hardness 3000 kg.
Annealed	90-110	40-60	45-35	140-180
Annealed, age hardened	130-150	90-110	30-20	240-260
As drawn	100-125	70-100	35-15	175-250
As drawn, age hardened	140-170	100-130	30-15	260-320

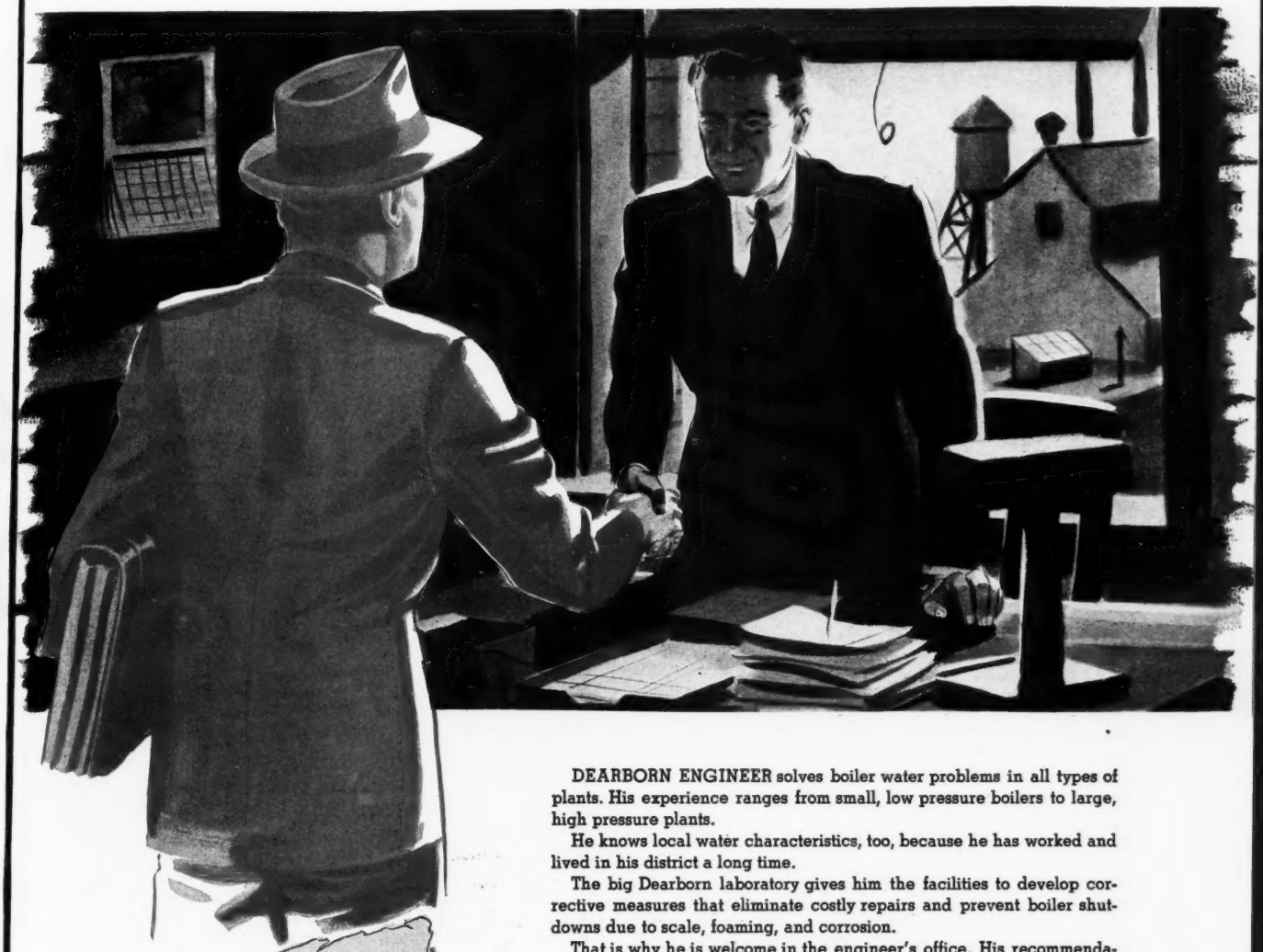
INCO NICKEL ALLOYS

MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • NICKEL • "Z" NICKEL

Sheet . . . Strip . . . Rod . . . Tubing . . . Wire . . . Castings

DEARBORN ENGINEER FINDS THE "LATCH STRING" OUT...

He knows how to solve boiler water problems



Dearborn Engineer does this for you . . .

(1) *Studies* your water and plant operating conditions.
(2) *Sends* samples of your water to main laboratory for analysis.
(3) *Recommends* proper chemical treatment and chemical control methods.
(4) *Supervises* installation of feeding equipment.
(5) *Instructs* your men on water test methods for treatment dosage adjustment and blow-down control.
(6) *Calls* regularly to insure maintenance of recommended conditions.

DEARBORN ENGINEER solves boiler water problems in all types of plants. His experience ranges from small, low pressure boilers to large, high pressure plants.

He knows local water characteristics, too, because he has worked and lived in his district a long time.

The big Dearborn laboratory gives him the facilities to develop corrective measures that eliminate costly repairs and prevent boiler shutdowns due to scale, foaming, and corrosion.

That is why he is welcome in the engineer's office. His recommendations point the way to trouble-free boiler operation. If there's a chemical laboratory in your plant, Dearborn Engineer cooperates with it . . . if not, there's more need than ever for his advice and assistance. And, he's a friend of purchasing agents . . . especially these days . . . because he helps to get prompt shipments of water treatment materials.

He's a good man for *YOU* to know. If you will write us, we'll gladly arrange for him to see you.

DEARBORN CHEMICAL COMPANY
Dept. F, 310 S. Michigan Ave., Chicago, Illinois

Dearborn

WATER TREATMENT AND ENGINEERING SERVICE

following comparative tests by National Bureau of Standards

WASHINGTON, D. C. *orders* 22 FOSTER SIRENS

Before placing an order for air raid sirens, the Commissioners of the District of Columbia asked the National Bureau of Standards to conduct comparative tests on the several types of horns and sirens offered for air-raid-warning service.

These tests conclusively proved that the Foster Siren has a higher average decibel rating — a wider range of audibility — than any of the other types tested. As a result of these tests, twenty-two Foster Sirens will be installed in Washington's permanent air-raid-warning system.

Before you purchase sirens, we suggest that you send for details of these tests and their results. A sixteen page booklet containing this information, as well as a descriptive folder on the Foster Siren will be sent without cost or obligation. Simply ask for Reprint MSE and Bulletin 41-S.

This siren not only can be heard for miles, but it needs no pampering. The simple design includes but few parts, and these are constructed to withstand "emergency service."

Furthermore, it works fast — its rising sound pitch or howl reaches its peak in from three to five seconds, depending on the maximum pitch for which this siren is set. And—it can be used for signaling because of its sharp sound cut-off.

If a constant pitch is desired, this siren can be so ordered or factory converted into a revolving cylinder-type of horn which produces practically a single pitch from starting to full speed, as contrasted with the conventional siren action with rising pitch or howl.

Type 30 Foster Siren
(Small Size)

Size of Valve:	1¼ inch (female thread)
Actuating Medium:	Steam or Air
Pressure:	50 lbs. minimum—200 lbs. maximum
Temperature:	450 degs. Fahr. (total)
Consumption:	Steam—approx. 1100 lbs. of steam per hour Air—approx. 500 cu. ft. of free air per minute
Diameter of Rotor:	3 inches
Diameter of Horn:	8½ inches
Net Weight:	60 lbs. (assembled)

Type 45 Foster Siren
(Large Size)

Size of Valve:	1½ inch (female thread)
Actuating Medium:	Steam
Pressure:	75 lbs. minimum—200 lbs. maximum
Temperature:	450 degs. Fahr. (total)
Consumption:	Approx. 3000 lbs. of steam per hour
Diameter of Rotor:	4½ inches
Diameter of Horn:	18 inches
Net Weight:	110 lbs. (assembled)

Both the Type 30 and the Type 45 Foster Siren can be furnished with a solenoid operated valve for electric remote control, either for separate "push button" operation, or tied in as an integral part of an air-raid-warning or fire-alarm system.

FOSTER ENGINEERING Company

PRESSURE REGULATORS... RELIEF AND BACK PRESSURE VALVES... AUTOMATIC STOP AND CHECK VALVES... ALTITUDE VALVES... DAMPER REGULATORS... FAN ENGINE REGULATORS... PUMP GOVERNORS... TEMPERATURE REGULATORS... LIQUID LEVEL CONTROLLERS... FLOAT AND LEVER BALANCED VALVES... NON-RETURN AND TRIPLE DUTY VALVES... VACUUM REGULATORS OR BREAKERS... SIGHT FLOW BOXES... STRAINERS... SAFETY VALVES... SIRENS

109 MONROE STREET · NEWARK, N. J.

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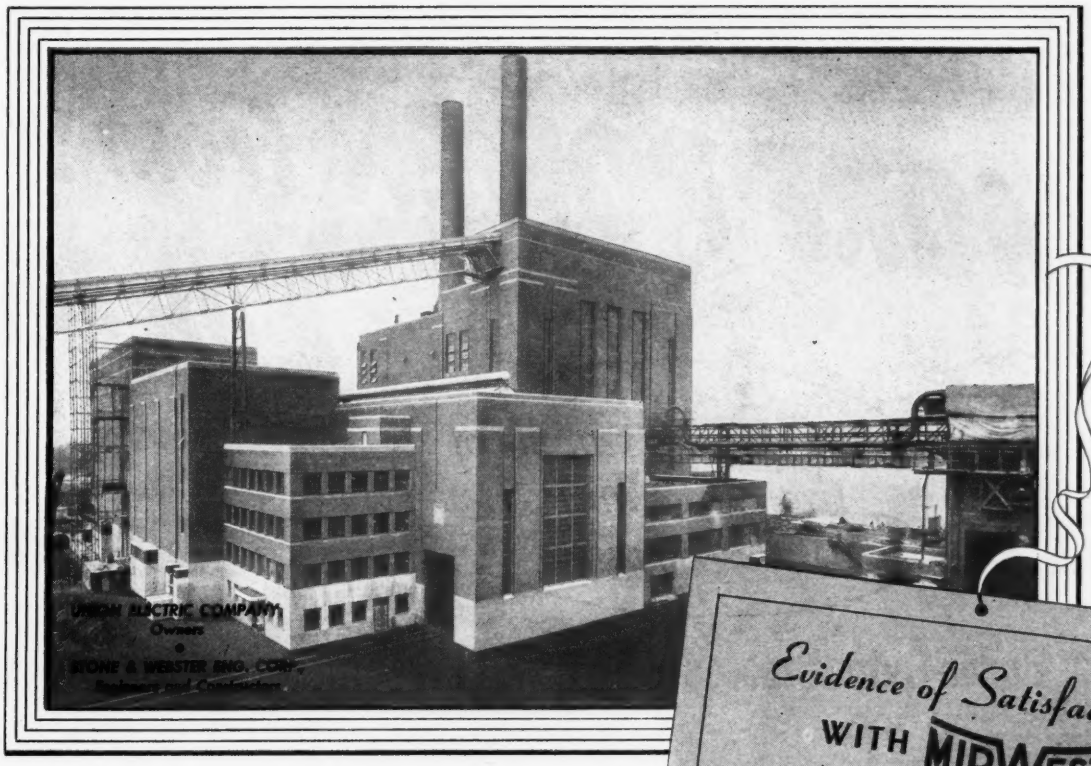


Evidence of Satisfaction
WITH MIDWEST
PIPING FABRICATION
AND ERECTION

AT VENICE NO.2 POWER PLANT

On the First Section (2-40,000 kw turbo-generators) of this new central station, Midwest was the piping fabricator and contractor. The results were so satisfactory that Midwest has been awarded all piping for the Second Section (1-80,000 kw unit) now being added as rapidly as possible.

A few interesting facts about the piping: High pressure steam and boiler feed have Hartford inspected welding —stress relieved throughout, both shop and field. High pressure steam piping is Carbon-Molybdenum alloy steel. High pressure steam and boiler feed piping are welded throughout except equipment connections; low pressure lines are welded with exception of valves and equipment connections. Erection was simplified and speeded because piping was pre-fabricated in the shop and delivered to the job as a series of carefully engineered sub-assemblies.

Whenever you need fabricated piping (either with or without erection), you will find it advantageous to use Midwest Piping.

Shop welding a sub-assembly of the 1500 lb. boiler feed piping. Note special rotating machine enabling qualified welder to always work in most advantageous position.

MIDWEST
PIPING & SUPPLY COMPANY, Inc.

MAIN OFFICE: 1450 SOUTH SECOND ST., ST. LOUIS, MO.
Plants: St. Louis, Passaic (N. J.) and Los Angeles

Sales Offices: Chicago—949 Marquette Bldg. • New York (Eastern Division)—30 Church St.
Los Angeles—520 Anderson St. • Houston—229 Shell Bldg. • San Francisco—535 Call Bldg.
Tulsa—333 Mayo Bldg.

MORE POWER from your ...with IRON FI

A Typical Example of Iron Fireman P.S. Performance

Boiler Output Increased 41%... Evaporation per lb. of Coal Increased 21%... Steam Costs Reduced 30% in Georgia Plant

JOHN M. CLARK
President, Georgia Vitrified Brick & Clay Company

MORE steam, at one-third lower fuel cost, is being produced in the boiler plant of the Georgia Vitrified Brick and Clay Company, Campania, Ga., by Iron Fireman Pneumatic Spreader stoker firing.

Three years ago one Iron Fireman P.S. Stoker was installed to fire two boilers.

The boilers are H.R.T. welded type, with 1470 square feet of heating surface.

Boiler tests made before and after the modernization of the plant included these highlights:

Evaporation per pound of coal increased 21%.

Maximum horsepower developed increased from 425 h.p. to 600 h.p., or 41%.

Cost of 1,000 pounds of steam reduced from 31.2 cents to 22 cents, or a saving of 30%.

Iron Fireman P.S. Stokers have helped step up Georgia Vitrified Brick and Clay Company's production, by maintaining constant steam pressure, with a 41% increase in capacity.

The labor cost of manual coal handling has been eliminated by the use of Iron Fireman P.S. Bin-Feed models. These stokers convey the coal direct from the main bin or bunker to the furnace, without using auxiliary coal handling equipment.

The Georgia plant reports remarkably low maintenance. No moving parts are exposed to the fire-zone, and the grate design insures ample cooling.

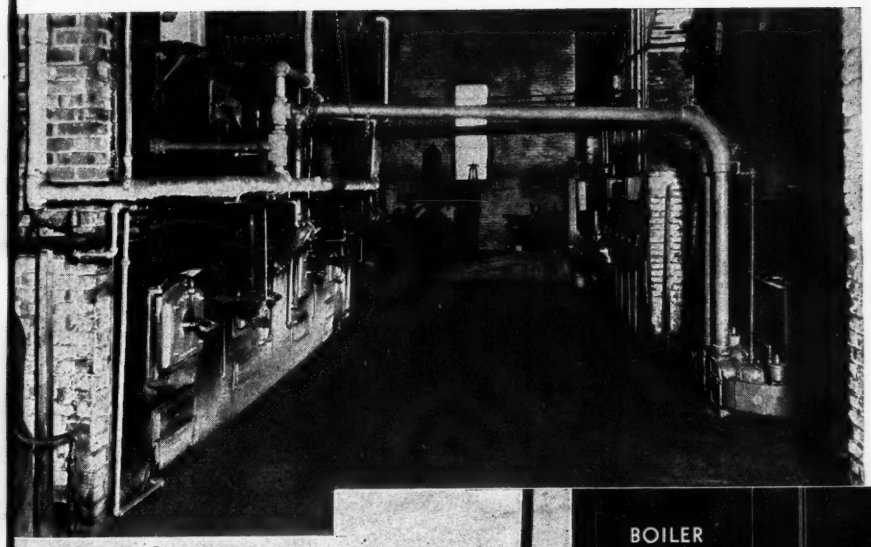
So successful has been the operation of the initial stoker in the boiler plant, that the Georgia Vitrified Brick and Clay Company has since ordered a second Iron Fireman P.S. stoker.

IRON FIREMAN
Automatic Coal Stokers

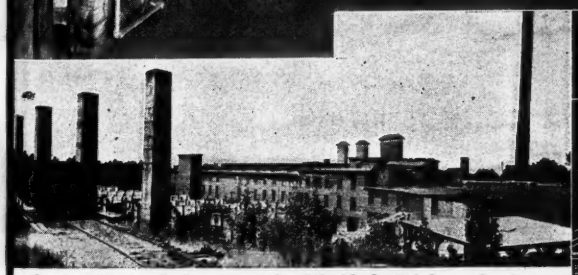
upresent boilers
on Fireman P.S.* STOKERS

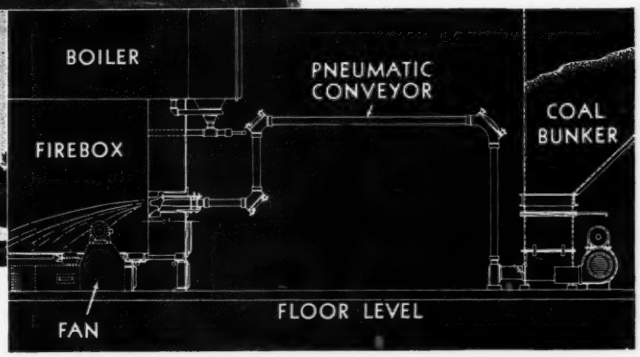
★ PNEUMATIC SPREADER

Iron Fireman Pneumatic Spreader stokers are obtaining 25% to 40% more steam, and steadier pressure, in boiler plants from coast to coast, assuring maximum output and improved quality of product. In the "Battle of Production," Iron Fireman stokers give *more fire-power!*

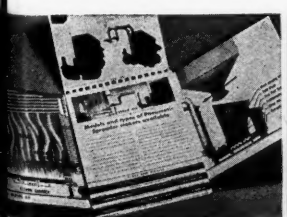


Left: One Iron Fireman P.S. stoker serving *two* boilers with its dual pneumatic conveying systems. One nozzle enters each boiler. The boilers were quickly adapted to Pneumatic Spreader firing. No alterations were required of the boiler front except the cutting of two small openings for the nozzles.



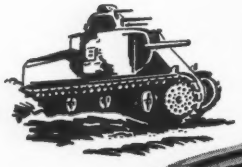


Above: Plant of the Georgia Vitrified Brick and Clay Company at Campania, Georgia—one of the largest of its type in the South. *Right:* Sketch showing how P.S. Bin-Fed model automatically conveys coal direct from main bin to boiler furnace.



FREE BOOK on Pneumatic Spreader Firing

Contains full descriptions, capacities, operating data, etc., with layouts and photos of 10 actual installations. Sent free, on request. Write to Iron Fireman Mfg. Co., 3315 W. 106th Street, Cleveland, Ohio.



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SILENT and ROLLER CHAIN DRIVES

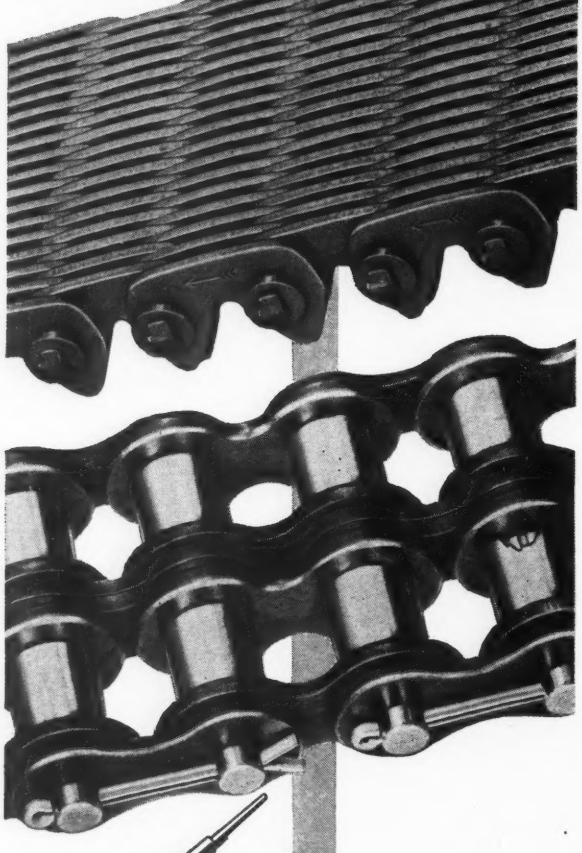
Meet Every Demand
No Slip—No Power Waste

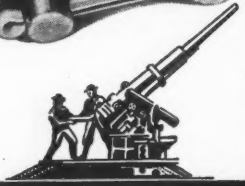
Power drives are vital in today's production rush. Beware of inefficient drives that cut down production through slippage and power waste.

Take advantage of Morse Silent and Roller Chain Drives. Their compact design, rugged construction and proven performance are your assurance of efficient power transmission and peak production. Smooth, dependable in operation, they set new records of trouble-free, economical service.

Morse Silent Chain Drives embody the famous patented "Rocker Joint" that rolls, not slips, the load—resulting in minimum resistance and wear for maximum efficiency and long life.

The Morse man in your territory will gladly assist in any of your drive problems—call him.





SILENT CHAINS ROLLER CHAINS FLEXIBLE COUPLINGS CLUTCHES

MORSE *positive* DRIVES

MORSE CHAIN COMPANY ITHACA N. Y. DIVISION BORG-WARNER CORP.

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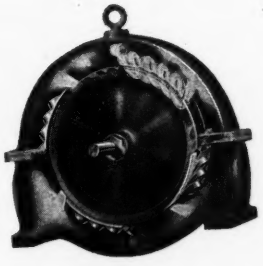

AN URGENT MESSAGE ABOUT TERRY TURBINE REPLACEMENT PARTS AND THE WAR EMERGENCY

The coming of active warfare makes it doubly essential that we conserve vital materials to the utmost.

We therefore urge all Terry Turbine users to:

- ★ Refrain from ordering unnecessary replacement parts.
- ★ Repair the old part if possible and make it do.
- ★ Keep spare part supplies down to a minimum.
- ★ And above all things not to overstock.

If all our customers will adhere to this policy, vital materials as well as valuable man hours will be saved for our defense work.

We earnestly solicit your cooperation.

T-1140

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

Take those tube curves fast!

Make an Elliott-Lagonda job of cleaning your curved tubes — that means a speedy job, and thorough too. There's a lot more to cleaning those short-radius curved tubes than just getting around the bends — you have to clean 'em too, at the same time! You have to use a cleaner that cannot only squirm its way through bend after bend, but that can put the "bite" on the toughest scale while doing it.

It takes an Elliott-Lagonda to do this double-barreled job, and it has taken a good many years of knowing how, to make the cleaner that will do it fast and well. Those years are working for you, when you use an Elliott-Lagonda.

There is plenty of experience on tap for you at "Tube Cleaning Headquarters." When the going gets tough, check with us. We can probably help. Write.

ELLIOTT COMPANY

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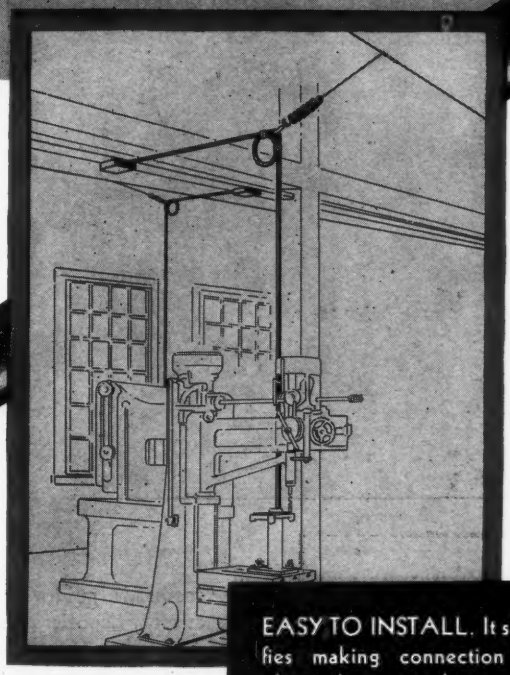
BUS-DROP CABLE

NOT A SPECK OF RUBBER IN IT!

NO CONDUIT NO PULLING



EASY TO INSTALL. It simplifies making connection from plug-in bus to machine.

By use of this bus-drop cable, you'll be able to make connection from bus to machine quickly—at a saving in installation time and materials. It's easily installed, simply by use of squeeze-type fittings and porcelain hanger. If a machine is re-located, usually the same cable can readily be used in the new location. This cable saves vital materials because it has no rubber and requires no conduit. Saves rubber; saves steel.

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It is better than rubber cable because it is highly resistant to oils and coolants. It will not support flame. Though not quite so flexible as rubber cable, it is easy to handle and easy to bend. And it has a lot of resistance to abrasion.

For safety to men and machines, this bus-drop cable has three ground wires, identified by green braid.

For quick identification, the conductors are insulated in red, white, and black.

When ordering, specify SI-58179, length, and conductor size.

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For control circuits—any number of conductors—specify Flamenol control cable in which each conductor is identified by its own individual color.

When you consider new wiring or re-wiring, for jobs of 600 volts or below, specify Flamenol. The G-E representative in your locality will help you select the right type. Or write to General Electric, Schenectady, N. Y.

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GENERAL ELECTRIC

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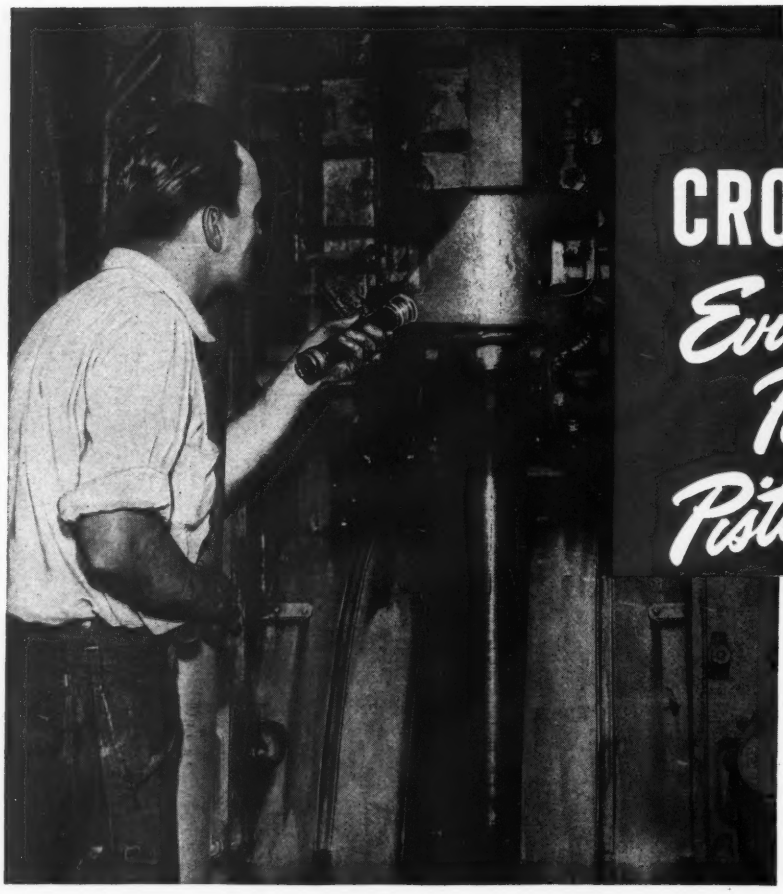
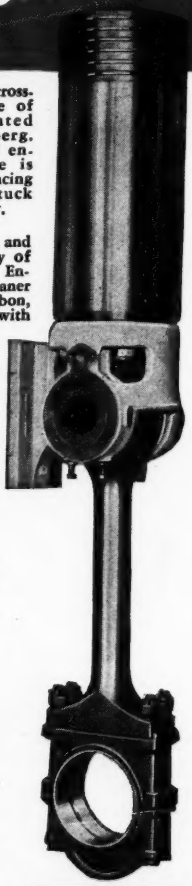


CLEAN CROSSHEADS *Evidence of Perfect Piston Seal*

Left. Inspecting crosshead and guide of Texaco-lubricated 1250-hp. Nordberg. Entire inside of engine's crankcase is clean . . . evidencing freedom from stuck rings and blow-by.

Right. Piston, rod, and bearing assembly of Nordberg Diesel. Engine parts stay cleaner and freer from carbon, when lubricated with Texaco.



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★ More revenue airline miles in the U. S. are flown with Texaco than with any other brand.

★ More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.

★ More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.

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FRED ALLEN every Sunday night. See your local newspaper for time and station.

Crossheads, guides and crankcases stay CLEANER, freer from sooty deposits due to blow-by, when you use *Texaco Algol* or *Ursa Oils.*

Highly resistant to the formation of gum, sludge and hard carbon, these Texaco oils keep piston rings freer, valves cleaner, ports open, assuring maximum power and greater fuel economy. Result—

More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.

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The Texas Company, 135 East 42nd St., New York, N. Y.

Care for your Car ..for your Country

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FOR POWER PLANT EQUIPMENT

HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY

POWER PLANT ENGINEERING

MAY, 1942
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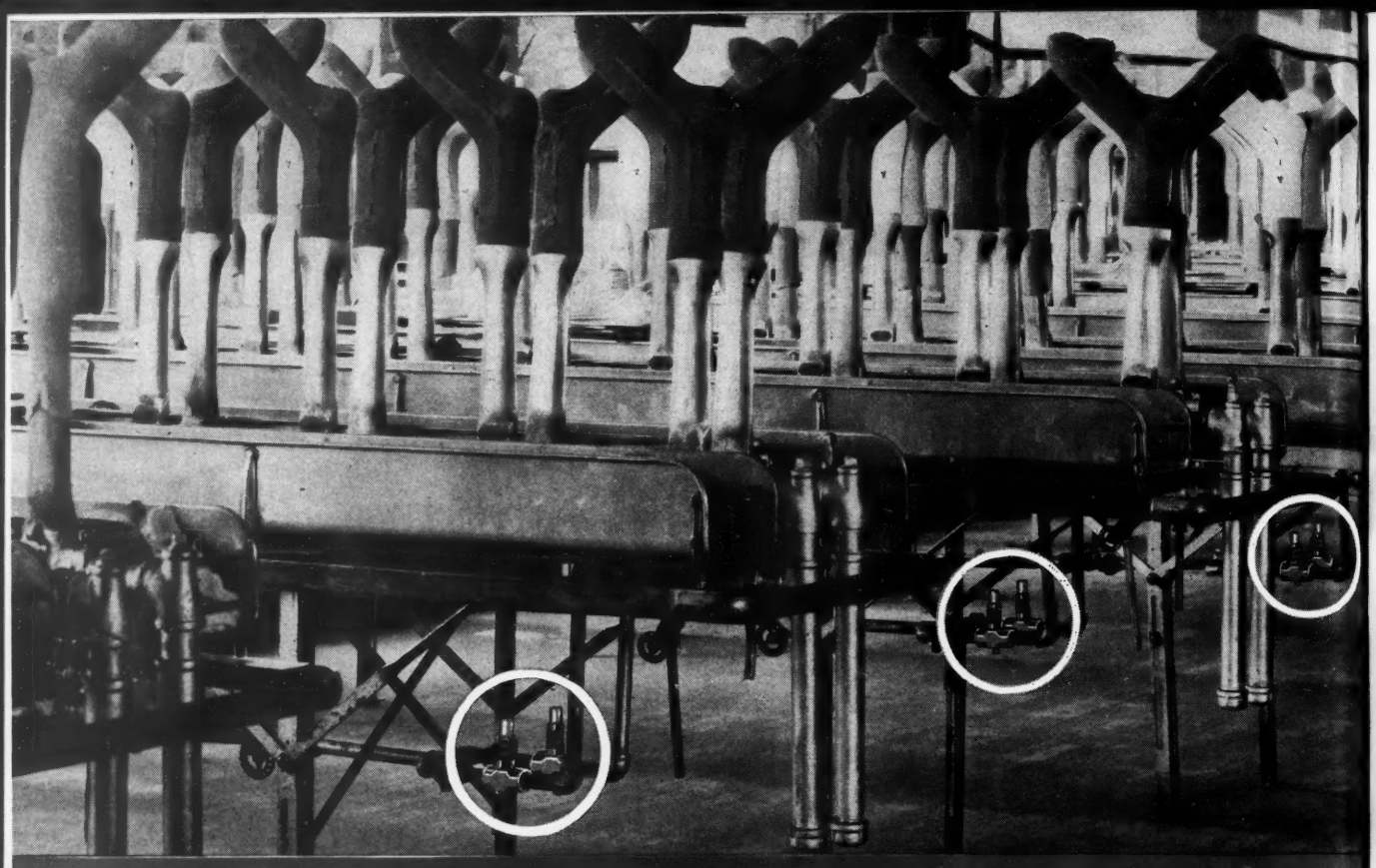


"Better Than Any Other Steam Trap I Have Ever Used"...

Says H. P. Tucker, Superintendent of Maintenance, Whisnant Hosiery Mills, Hickory, N. C.

"I LIKE the Yarway Impulse Trap better than any other I have ever used. They have been in service on our stocking drying forms for over 2 years and have not required any maintenance," Mr. Tucker reports.

This is the kind of dependable, efficient, trouble-free service that has sold more than 130,000 Yarway Impulse Traps throughout Industry.

Install a Yarway Impulse Trap or two and let them demonstrate what they can do for you in *speeding production* and *saving fuel.* See how its *small size saves space.* How its *light weight simplifies installation.* How its unique design with *only one moving part,* and its rugged *bar-stock construction,* practically *eliminate maintenance expense.* Then too, Yarway Traps are *suitable for varying pressures without change of valve or seat.* And when you consider that their *purchase price* is usually *no more than the cost of repairing an ordinary trap*—why not get Yarway performance for your money?

A nearby Mill Supply Dealer handles them and will be glad to serve you. Or write for Bulletin T-1736.

YARNALL-WARING COMPANY, 114 Mermaid Ave., Phila.

YARWAY IMPULSE STEAM TRAP

WITH THE EDITORS

◆ **YOU CAN'T BOTTLE KILOWATT-HOURS** . . . During recent weeks there have been issued a number of statements in regard to the saving of electric power. In one of President Roosevelt's press conferences he requested the newspapers and the radio to appeal to government agencies in the field and to civilians all over the country to save all possible electric power for war use. In Chicago, at his press conference on March 5, Mayor Kelly urged the public to keep use of power at the lowest level possible. "Turn off the lights," he said. "Many use two lights when one would do. Turn off the radio. Turn off the electric range, vacuum cleaner, the roaster, the orange juicer, toaster, mixer and washing machine.

The President's appeal, and Mayor Kelly's as well as similar ones by others were no doubt sincere, made in good faith, but it is seriously to be questioned whether such a course of action would help the war effort appreciably. As general advice it is sound, certainly we would never question the desirability of turning out lights when they are not needed, nor would we object to having a good many radios turned off—the latter, particularly, is a step in the right direction—but we doubt whether the practice would save any power for war industries. Such civilian curtailment of power use would save a small amount of fuel, but fuel for power stations seems to be one of the commodities we still have enough of. As far as helping the war industries is concerned, however, the effect of such curtailment is small.

A kilowatt-hour not used cannot be stored away for later use by a vital war industry. True, it can be used by such an industry at the time it is "saved," but unless the system from which it is taken is running at its absolute limit of capacity there is little need to "save" it.

◆ **IT ONLY REDUCES UTILITY REVENUES** . . . As a matter of fact this saving of power by civilian consumers is not urged by either the Federal Power Commission or the power division of the War Production Board.

Speaking before The American Institute of Electrical Engineers recently, J. A. Krug, of the W.P.B. said "Electricity is too important a public service to encourage or invite curtailment when it is unnecessary, though I am confident that when such measures become urgent, the American public will respond. . . . It should be borne in mind, however, that curtailment and rationing are no cure-all for lack of power capacity. In many areas the curtailable loads, that is, the power used over and above consumption by war industries and essential civilian requirements, is only about 10 per cent of the total. In such areas, curtailment should be resorted to only as the final expedient. This little buffer between capacity war production and a handicapped war effort should be reserved for those emergencies which are certain to come." In other words, what is meant here, is that civilian curtailment of power can be effective only when power systems are running at the limit of their capacity. The idea behind civilian curtailment is not necessarily to save "power" but to save generating capacity and until such generating capacity is in full use, the turning off of lights and radios will only result in decreased revenue to utilities. Whether this is desirable is something entirely apart from the subject under discussion.

◆ **EFFECT OF WAR TIME** . . . The same misconceptions that exist in the mind of the layman in regard to the "saving" of power discussed in the foregoing paragraphs have their counterpart in his ideas regarding the effect on power consumption of war time. Perhaps this statement is a little unfair because, since war time went into effect in February he (the layman, or John Q. or the man-on-the-street) has been not a little puzzled. If he saved electricity at night, he used more of it in the morning when he got up before dawn. Certainly, his electric light bill did not seem to reflect any saving. Still, he had read that the change to war time would save power so he accepted the fact on its face value.

The fact is, of course, that the change to war time was not made to save power. It may save a very small amount of power—the Federal Power Commission's estimates of the saving for the nation as a whole, are 0.035 per cent—but this is so small as to make it practically negligible. What war-time does is to shift the peak demand. As is well known to power engineers the one factor determining the size of any power plant is the maximum demand that that plant may be called upon to deliver. Since this peak demand occurs only for a short time during any day or month or year, it follows that if at least a portion of the peak load can be shifted to some other time of the day or year, the plant or system involved will have just that much more reserve capacity to take care of emergencies.

The saving in power is negligible, but the change in time makes it possible to carry the same volume of electric light and power with less generating capacity. This releases generators that may be needed for industry for the manufacture of war materials.

◆ **GETTING THE SABOTEUR** . . . A point regarding sabotage brought out by Frank Starr of the General Electric Co. in his article on power system protection in this issue is worthy of comment. In considering anti-sabotage activities in connection with the protection of our systems, Mr. Starr makes one fact stand out—that it is impossible to make our power systems invulnerable to sabotage, that whatever we do for protection should follow the basic principle of *getting the saboteur* rather than *preventing sabotage.*

Sabotage is easy, especially to anyone skilled in the particular field with which he is concerned. He knows all the vulnerable points and in most instances has sufficient knowledge and intelligence to circumvent protective systems that may be installed to prevent sabotage.

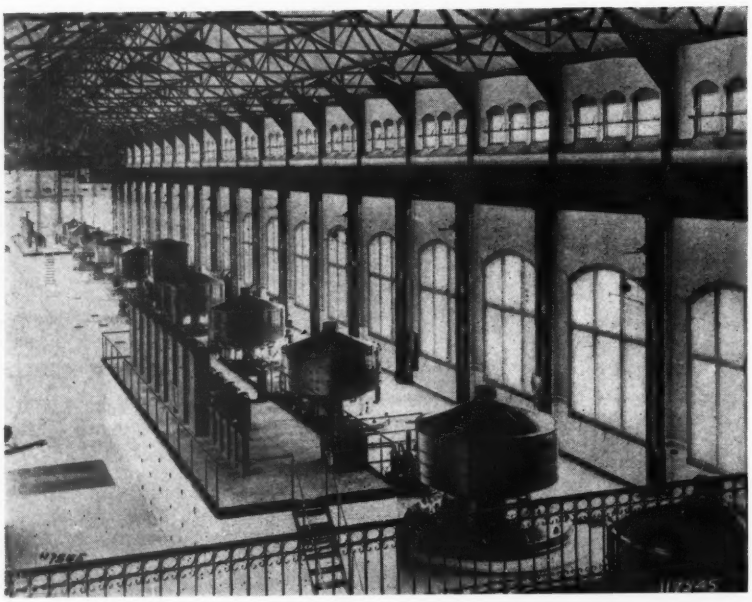
The obvious thing, then, is to get him at his first attempt and then fix him so that he can do no more damage for the duration at least. The more saboteurs thus apprehended, the less will others of his category attempt to do damage. To that end, as Mr. Starr points out, probably the best protection is afforded by a well organized and well trained patrol. Many such patrols are now functioning on our large power systems to good advantage. The saboteur is clever, often ingenious, but constant vigilance can show him up and once that is done the rest is easy.

◆ **CRYING NEED** . . . The more we attend engineering meetings the more do we become convinced that one of the most crying needs in this country is a course in our engineering colleges leading to a degree in P.O. The P.O. stands for "Projector Operation." In suggesting this it is true the institution of such courses would take away a good deal of the fun that now prevails at engineering meetings. Many engineering meetings would be dull indeed if the projector operators did not get the lantern slides all mixed up or put them in the projector upside down or wrongside to, but even so, for the sake of the reputation of the engineering profession, something should be done about this evil. If these things happened at a haberdashers convention they might be excusable, but at engineering meetings where we should assume the presence of some technical skill they have no place. Yet it is at engineering meetings that the slides are either put in upside down or will not fit or the public address system goes haywire or something of a similar nature happens. Maybe the solution consists in the development of a projector in which the slides could not be put in incorrectly or in improper sequence but it seems to us that the most effective way out is a 4-yr. course in projector operation. Graduates of such a course, we feel certain would be in great demand and they probably could name their own salaries, provided, of course, they were accustomed to dealing in low numbers. Their presence at engineering meetings would do much to raise the standards of the engineering profession.

ELECTRIC POWER GENERATION

TODAY the strength of armies and navies is measured by the industrial power behind them. By industrial power, of course, is meant manufacturing capacity—our tools and factories, our transportation and comunication systems and our capacity for refining and developing raw materials for use in the factories. In this respect, we Americans have reason to be proud of our industrial might. We have what it takes. We have a natural heritage of great factories, raw materials, tools and skilled man power. America is pre-eminently a nation of light and power. No other country in the world has such a combination of natural, human, and mechanized resources.

Our economy, however, has been a peacetime economy. Our men and machines have been highly specialized in making automobiles, radios, refrigerators, and other things which improve the standard of living, at least so far as convenience is concerned. But ordinary automobiles and radios and refrigerators are of little value in war. An automobile is no match for an armored tank and so in order that our great industrial capacity may be of use to us in meeting the enemy, we have literally to rebuild it completely. As yet we are still awkward in making the implements of war. We must and will make them, however, and so we are engaged in the most difficult and most amazing industrial reorganization in the history of the world. Almost overnight—in the space of a year perhaps, we must do it on a much larger scale that which Germany did over a period of 10 yr.



The Old. To supply vital power for the war effort, the ten original Westinghouse waterwheel generators at the Niagara Falls Power Co's Adams Station were recently put back into regular operation after having been out of service for 17 yr.

Even this year, during the very time this great reorganization of industry is taking place, we must produce some 60,000 war planes, some 40,000 tanks, and machine and assemble 20,000 precision-built anti-aircraft guns. And in this same year we must weld together and equip 8 million tons of merchant shipping.

It is unnecessary to be more specific. We are all more or less conscious of them. Nothing has been said regarding vast quantities of shells, bombs, ammunition or the equipment needed for an army of millions of men, but all of these things provide us with some conception of what is involved in this mightiest of all efforts.

The war effort cannot be measured in terms of billions of dollars. We have grown so accustomed to seeing and hearing about billions of dollars that they have ceased to carry much meaning. To say that

In all the war effort, in everything that is done to enable our fighting forces at the fronts to win the war, no single commodity that we use is as important as power. In peacetime or in wartime power is the essential keystone in the arch of industrial production, but in wartime its importance rises above everything else. In this general article we present a discussion of the elements that enter into the problem of supplying the nation with an adequate quantity of power under war conditions. Great as our power resources are, the war effort still makes it necessary for us to grind out every possible kilowatt-hour of energy we can. It is no longer a question of how much power will be needed; the object must be to produce all we can and as speedily as possible. This article presents the general picture. Other articles in this issue deal with more detailed aspects, such as transmission and distribution, emergency power, methods available in augmenting present generating capacity and anti-sabotage work

IN WARTIME

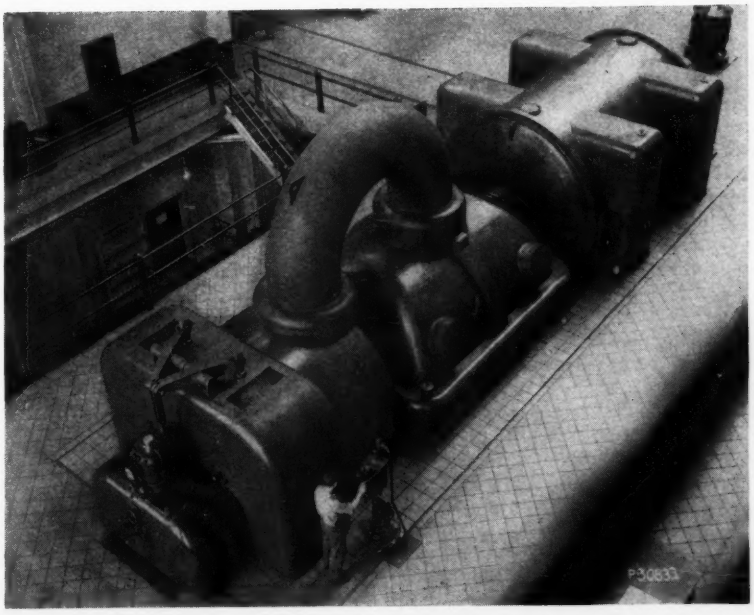
we must spend so many billions to win the war is meaningless, because we will spend whatever it takes. The same is true of the amount of power needed.

As was pointed out in a recent address by J. A. Krug of the Power Division of The War Production Board, it is no longer a question of how much power is needed; the object must be to produce all we can and as speedily as possible. Every possible kilowatt-hour that we can squeeze out will add to our strength.

The desired result will not just happen. An assured power supply for war industries requires the most detailed and careful planning. Every kilowatt of power must be utilized to maximum advantage. This can be accomplished only by the most skillful operation and the most complete co-ordination of our power resources and superhuman foresight in the location of new industries.

The planning of war power production is the government's responsibility, but the execution of these plans is the responsibility of the power engineers of the country, industrial and central station men alike.

Fortunately, in terms of electric power we were better prepared to met the first war needs than other industries. Compared to the war needs our peacetime aluminum and magnesium capacity was insignificant and the first surge of the war effort swallowed up the nation's entire output.



And The New. The new 35,000-kw. turbine-generator recently built by Westinghouse begins its service in the war effort at the Toronto Station of the Ohio Edison Co. It operates at 3600 r.p.m. and is hydrogen cooled

Electric power was electric power regardless of whether it was destined for war production or peacetime needs and when the war came to our doors we had a good foundation of available generating capacity to start on. At the present time, according to Mr. Krug, over 51 million kilowatts of effective power capacity is available for service.

To this great reservoir of power we are adding this year about 2,200,000 kw. of steam and 1,000,000 kw. of hydroelectric capacity. Unless the shipbuilding program now under way requires an even larger proportion of our turbine production than now contemplated, power projects now under construction will add an additional 2,000,000 kw. of steam and 1,000,000 kw. of hydro in 1943 and long range jobs already under construction will bring an extra 1,250,000 kw. into the picture in 1944.

There is no valid reason why this program will not be carried out. Some weeks ago (this is be-

POWER AND ENERGY RESOURCES OF THE WORLD[1]

Installed Prime Mover Capacity in U. S. A. and Canada
(Horsepower)

United States		Canada	
Industrial power plants	20,133,000	Central stations, hydro	7,104,142
Electric central stations	51,000,000	Central stations, steam	200,000
Electric railway plants	2,500,000	Mfg. Int. comb. engines	88,265
Isolated nonindustrial plants	1,500,000	Mfg. Steam eng. and turb.	774,166
Mines and quarries	2,750,000	Mfg. Hydraulic turbines	606,717
Agricultural prime movers	72,763,000	Other hydro installations	482,151
Cars, buses, trucks, etc.	965,000,000	Airplanes	241,000
Airplanes	3,500,000	Locomotives	9,370,000
Locomotives	88,000,000	Marine	3,000,000
Marine	30,000,000	Agricultural	7,000,000
		Automobiles	46,300,000
	1,237,146,000		75,163,650

World Output of Electricity	Technate of America[2]	Rest of the World	World Total	Technate Per Cent of World Total
Kilowatt-hours	151,528,000,000	272,472,000,000	424,000,000,000	36
Kw-hr. per capita	770	141	200	385
World Fuel-energy Resources				
Coal (tons)	5,627,823,000,000	2,526,499,500,000	8,154,322,500,000	69
Petroleum (bbls.)	13,706,000,000	8,259,000,000	21,965,000,000	62
Gas (cu. ft.)	62,000,000,000,000			80*
World Waterpower hp. (1938)—				
Developed	27,077,000	36,923,000	64,000,000	42
Potential	91,800,000	579,200,000	671,000,000	14

[1] This data was taken from a tabulation published in "Technocracy" which in turn, had compiled it from various sources. The data on prime movers for U. S. A. was obtained from "Technological Trends and National Policy," 1937, but the figure for central stations was brought up-to-date to 1941. Canadian figures are from "Canada Yearbook".

The data on the world output of electricity is from "The Statistical Yearbook of The League of Nations, 1938-39" and from the U. S. Dept. of Commerce. Coal data from T. A. Hendricks, Geological Survey, U. S. Dept. of Interior. Petroleum data by Garfias and Whetsel, "Proven Oil Reserves", and water power data is from the Geological Survey, U. S. Dept. of Interior. May, 1939.

[2] By Technate of America is meant, the United States and the countries strategically and economically associated with it, i.e., Alaska, Bermuda, British West Indies, Canada, Colombia, Costa Rica, Cuba, Curacao, French Guiana, Haiti, Hawaii, Labrador, Mexico, Newfoundland, Panama, Puerto Rico, Trinidad and Tobago, Venezuela, etc.

ing written in March) a rumor was current to the effect that all deliveries of generating equipment scheduled for this year to private power companies had been cancelled and that the entire manufacturing facilities would be devoted to the Navy. According to information obtained direct from the Office of Emergency Management there is no truth to this rumor. It is true that heavy Navy demands are compelling deferment in 1943 of some generating equipment scheduled for delivery this year, but substantial amounts of new generating equipment in both steam and hydro scheduled for delivery this year will be delivered on time and will be added to the nation's power facilities before the end of this year.

"Sorry, sir, even if you are president of the company you still need a pass to get in here"

Our 54,000,000 kw. of installed capacity which we had at the beginning of this year represents a large amount of producing power. Last year it generated some 160 billion kw-hr. To understand just what this means, however, it is of interest to compare it with the power production of our enemies —those of the Axis.

Leland Olds, Chairman of the Federal Power Commission, recently asked the staff of the Federal Power Commission to survey the power supply of the Axis powers.[1] Using World Power Survey figures brought up to date on the basis of consular reports, they estimated that by 1943 the Axis powers would be in command of electric power at the rate of 200 billion kw-hr. a year. These figures were released in November of last year and probably do not include Japan's power resources.

From this comparison it is evident that great as our power producing facilities are they are only about equal to those of the enemy. Yet adequate power supply spells plenty of aluminum, magnesium, metal alloys, synthetic rubber, and a score of essential metal and chemical products.

Our aluminum program has recently been expanded to bring the ultimate production to 1,400,000,000 lb. a yr., the corresponding program for magnesium calling for 400,000,000 lb. a yr. Since each pound of aluminum requires 10 kw-hr. of electricity and each pound of magnesium 10 to 15 kw-hr., we will need about 20 billion kw-hr. for aluminum and magnesium alone.

It is needless here to try to estimate or to refer to detailed estimates already made by the Federal Power Commission as to the probable loads which the war effort will impose upon us, because it has become evident that even the best estimates are unable to deal with possible future happenings. The Federal Power Commission's estimates made last fall on the basis of a war expenditure running at a rate of 3 billion dollars per month assumed that the nation's requirements in 1943 would be 215 billion kw-hr. or approximately equal to those estimated for the Axis powers, but this has already been altered by an increase in the rate of expenditures to well over 50 bil-

[1] Power for Defense. By Leland Olds. An address before the American Institute of Electrical Engineers, Washington, D. C., Nov. 17, 1941. Published in Electrical Engineering, January, 1942, p. 3.

lion dollars a year. If Leland Olds is correct in his statement, that every dollar of war effort spending requires 2¾ kw-hr.[2] of electric energy then our 50 or 60 billion dollar a year spending program alone will require from 137 to 165 billion kw-hr.

Despite the difficulty in anticipating future loads, the Federal Power Commission has been attempting to plan so that at no time will the national safety be jeopardized by lack of adequate and dependable power supply. Each month the Commission's staff surveys the power requirements and the supply situation in the 48 power supply-areas into which the country has been divided.

Thus far, except in the Southeast where there was a shortage due to drought last year, there has been no important shortage of power and there is no reason to expect any shortage this year. It is possible, of course, that local shortages may develop in certain defense areas as a consequence of the construction of new industries, but intelligent planning can keep such instances to a minimum. This does not mean that we can sit back and let the power situation take care of itself. Today the demand for power in many regions is growing faster than the capacity to supply the new demands. On the Chicago system, for example, where the effective generating capacity is 2,146,000 kw., including the 161,000 kw. capacity added during 1941, the peak load during the winter season was approximately 1,790,000 kw., giving an excess over the peak load of some 350,000 kw. This, compared with a reserve of 385,000 kw. over the 1,600,000 kw. peak load of the previous winter.

The effect of the war program on generating capacity as estimated by the Federal Power Commission is shown by Fig. 2.[3] This chart is based on data available last October. In this chart the United States has been divided into eight regions and for each the actual load in 1940 and the estimated load for 1943 are shown in the form of bars. Indicated also are the net assured generating capacities that were available in 1943, providing there is no delay in delivery of generating equipment already ordered. From this chart it will be seen that except in power areas 3 and 5 those of the extreme Southeastern and extreme Northwestern States, the anticipated available capacity in 1943 is in excess of the estimated load.

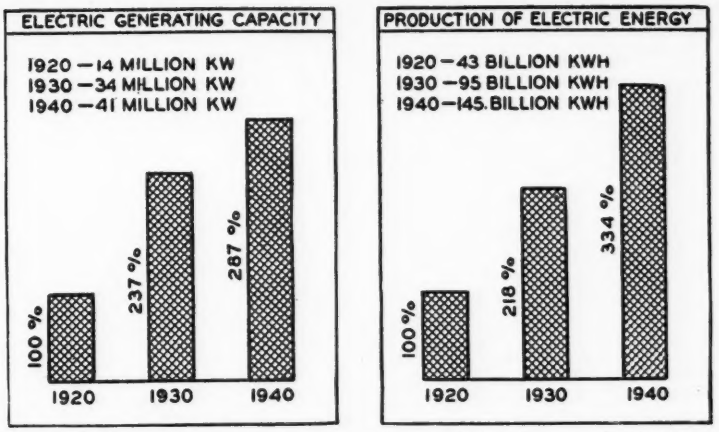


Fig. 1. Electric generating capacity and production of electric energy in the United States, 1920-30-40

The critical situation in the Southeast last year was due to excessive drought. Heavy rains in July temporarily ended the first critical period, but the situation was studied by the Federal Power Commission and arrangements were made to supply additional energy to this area by interconnection and limited curtailment was put into effect until the winter rains could replenish the reservoirs.

It is unnecessary to discuss the situation in detail, but this indicates the nature of the problem. In its solution, interconnection is of vital importance, and studies have been made to strengthen our already substantial interconnections in various regions. One of the measures explored has been the possibility of interconnecting our major centers in the Northeastern industrial area. The utilities in the eastern part of the country have been co-operating in these studies. Preliminary studies indicate that considerable diversity in load exists between systems, some of which are not now

[2]Power for Defense. By Leland Olds. Ibid.

[3]Power for Defense—National Program by Thomas R. Tate. January, 1942 issue of Electrical Engineering.

The second half of the world's largest power house now under construction by the Bureau of Reclamation at Grand Coulee Dam will house, when completed, 9 of the 18 giant 108,000-kw. generators which will make up the entire ultimate installation. In the first half of this power plant on the opposite side of the river three of these generators are in operation. The third generator was placed in service on Tuesday, April 7

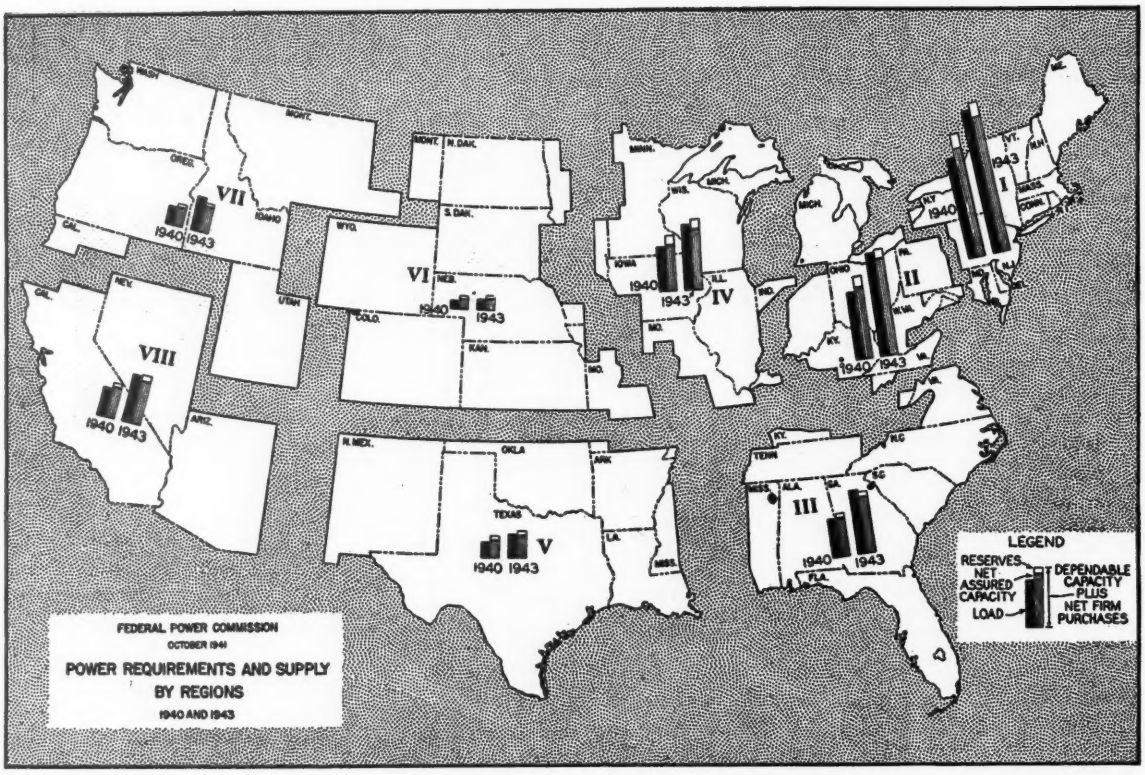


Fig. 2. Electric power requirements and supply in the United States by regions, 1940 and 1943

interconnected, and that a considerable amount of reserve capacity normally required in each area might thereby be released for actually carrying loads.

Diversity

This question of diversity is extremely important because it is in the direction of reducing diversity that we find the greatest opportunities for improving our load carrying ability. It is in this connection that daylight savings or "war" time is of advantage. Among the general public, especially during the month of February, there was considerable good-natured grumbling about getting up in the dark and that any saving in light in the evening was more than offset by the lighting needed in the morning. This, of course, is true and even the Federal Power Commission was very conservative in estimating savings in power. They calculated an annual overall saving in power of 0.035 per cent. As a matter of fact, in several metropolitan areas the amount of power used actually increased as a result of the change in time. In Cincinnati there was an increase in February and March. But the change in time does spread the load. In winter the decrease in load during the evening peak may be just sufficient to enable an existing system to supply the demand.

In metropolitan areas like Chicago and New York the operating companies estimate that the use of "war time" should save approximately 100,000 kw. in each area during the time of the annual peak. Furthermore, by providing an improved load factor, it results in a more efficient use of our fuel resources.

The Influence of Power Rationing

The question of power rationing has come up frequently in recent months and in some regions as in the Southeastern areas already referred to curtailment of power for certain uses was imposed. As pointed out by J. A. Krug of the War Production Board, however, electricity is too important a public service to encourage or invite curtailment when it is unnecessary. No doubt the American public would respond to a plea for curtailment, but until such curtailment is urgent it should not be demanded. Curtailment, or rationing, furthermore, are not cure-alls for lack of capacity. According to the War Production Board, in many areas the curtailable loads, that is the amount of power used over and above consumption by war industries and essential civilian requirements is only about 10 per cent of the total. In such areas, curtailment should be resorted to only as a final expedient. The remedy of curtailment is no substitute for the remedy of adding plant capacity, of well-co-ordinated operation, and other emergency measures that can be employed. This little buffer between capacity war production and handicapped war effort should be reserved for those emergencies which are certain to come, regardless of every step we can take under the most diligent planning.

Industrial Power Plants

In all this discussion of power so far the industrial power plant has not been considered. In the various estimates of the Federal Power Commission and other organizations issuing weekly or monthly reports, only the central stations, both public and private, are considered. There are few over-all statistics on the amount of power generating capacity installed in industrial power plants, but from data gathered by the National Resources Committee, it can be approximated at around 16 or 17 million kilowatts. The total kilowatt-hour output of

these plants is estimated by the F.P.C. at 37 billion kw-hr. annually, but this can without doubt be stepped up. The load factor on the majority of industrial power plants has been low because in the past, few plants have operated 24 hr. a day. As factories come into 24 hr. a day operation, the power plants supplying them can come into 24 hr. a day operation. In other words, in such plants the existing generating capacity should be able to take care of the greatly increased production schedules. The serious problem likely to be encountered here is that of maintenance and repair. Many industrial power plants have not had the care and attention they should have had to keep them in top-notch shape—largely because industrial power plants, too often, are considered only as necessary evils—and under the strain of continuous operation it is inevitable that trouble will develop. It is to be hoped that an intelligent attitude will prevail regarding priorities for such plants, since it is highly important that these plants be kept running. Every kilowatt of effective installed capacity in industrial power plants is equivalent to more than that in a central station because it relieves not only the central station but the transmission and distribution lines of handling the power. Industrial power plant capacity, representing as it does well over a fourth of our total power productive capacity, should receive careful study and consideration.

There is another very important reason why the industrial power plant should receive careful consideration and that is in the interest of fuel conservation. Most industrial power plants produce large proportions of their electrical output more or less as a by-product of the heat energy necessary in any case for heating and industrial process work. As far as the over-all effect is concerned fuel is used more effectively in the average industrial power plant than in the central station where so large a proportion of the total heat energy in the fuel is discarded in the condensing water. Every power plant engineer knows this, but the general public does not and unless there is intelligent action in this respect by administrative bodies and officials, harm to our war program might result. No industrial power plant connected in any way with war work should be permitted to shut down even in part for lack of parts or commodities necessary for its operation.

In this discussion nothing has been said about many other aspects of the power problem in war time, but these will be considered in detail in other articles in this issue. The question of distribution systems for example—how to adapt them to greatly increased loads—is extremely important. Emergency power sources, mobile plants, temporary interconnections, the construction of emergency sources from old or used equipment, these and many other things enter the picture.

Making Use of What We Have

Many things can be done in an emergency. We in this country are so conditioned to using only the best and most improved methods that we do not like to think of makeshifts, but in extreme cases there is no reason why certain machines in factories could not be driven directly by internal combustion engines of the automobile type. Certainly there are plenty such units in existence. Compared to the installed capacity in automobiles, the installed capacity in electric generating stations is small indeed. Compared to the 68 million kilowatt installed capacity in power stations (combined central station and industrial plants) it is estimated that there is approximately 750 million kilowatt of engine capacity installed

". . . well, he had a pass"

in the automobiles in this country. By and large, this capacity cannot be adapted to manufacturing purposes, but in time of acute power shortage it might be expedient to utilize some of these engines in other ways than in running motor cars.

In this problem of power supply as in all other things associated with this world conflict it will be necessary for us to revise our ideas considerably. From an engineering standpoint we have produced some of the most efficient generating plants in the world. We have cut our national coal consumption from around 3 lb. per kw-hr. to around 1 lb. per kw-hr., a most admirable achievement, but it may be desirable in these times to lay less stress on high efficiency and put more effort in building every possible kilowatt of capacity we can.

Each pound of aluminum requires 10 kw-hr. of electric energy. Direct current for the production of aluminum is supplied by this line of ignitrons whose total rating is 60,000 amp. at 645 v. (Photo, courtesy, Westinghouse)

Power Distribution Systems In Wartime

With the increased loads imposed on our power systems by the war effort, the electric distribution systems of the country become the real bottlenecks of the power problem. They will have to be stretched so as to carry every last kilowatt-hour produced and in order that they may do that it may be necessary for us to revise somewhat our conception of what constitutes good practice. This article which is based on a symposium of papers on this subject at the recent A.I.E.E. meeting describes various means whereby the usefulness of our distribution systems can be extended and adapted to meet the increased load requirements imposed by the war

DISTRIBUTION systems as we know them and as they exist today are the products of concepts and ideas which have developed as our experience with the distribution of electrical energy accumulated. These concepts are based upon knowledge of the physical and electrical requirements of distribution systems and upon the corresponding abilities of different classes of materials to meet these requirements. In many cases, however, the requirements themselves are based upon more or less arbitrary criteria of what is required to give satisfactory performance. For example, it is apparent that while there is much experience behind the common practice of designing distribution feeders for 2 per cent voltage drop to the distribution centers, it is perfectly possible to design, build and operate distribution systems with higher feeder-voltage drops. This is but one example illustrative of the fact that many parts of the distribution systems have been built to meet more or less arbitrary standards. This implies no criticism of distribution engineering practice, it means only that the standards do not represent the minimum that can be safely used. In this country we have been accustomed to accept only the highest quality of performance and it may well be that in these critical times our standards of performance are higher than they need be.

Thus, in considering our electrical distribution systems for service under wartime conditions it is necessary to determine just how far our standards of design and performance can be modified in directions of saving material and effort and yet meet the wartime needs.

Nearly all distribution systems that have maintained normal standards of adequacy have considerable elasticity, that is, they are capable of carrying more load than they have ordinarily been considered capable of carrying safely. This may mean that underground cables as well as transformers and other equipment might be operated at higher temperatures with consequent decreased life. In peacetime such practices could not be condoned from the standpoint of economy, but in wartime economy becomes of secondary importance.

Not only in operation but in maintenance also a closer examination of the true needs of distribution systems are in order. This again may lead to higher costs. Deferred maintenance, for example, always leads to higher ultimate costs, but there is often considerable difference between what might be called clearly deferred maintenance and what is merely anticipatory maintenance. Failure to heed the violent sparking of the commutator of a large rotary converter would most certainly result in serious injury to the machine and it would be extremely unwise to neglect taking care of such a condition at once. Failure to renew the oil in a certain transformer, on the other hand, while it might result in seri-

Subjects Covered by A.I.E.E. Papers on Power Distribution in Wartime

Overhead Cole	Underground Gaty	Dist. Substations Poage and Reid	Supply to Dist. Substations St. Clair
Critical Material Involved	Method of Supply	More Use of Existing Equipment	Transmission Substations
Means of Conserving Material	Reliability of Supply	Obtaining Additional Circuits and Releasing Switching Equipment	Portable Car-mounted Transformers
Increased Loading of Existing Facilities	Underground Equipment Limitations	Economies and Conservation in New Work	Switching Equipment
Rearrangement of Existing Facilities	Insulation Requirements	Restoration of Service	Tapping Transmission Lines with Low Cost Substations
Salvaging Operations	Duct Limitations	Protection and Preservation of Equipment	Sub-transmission Lines. Existing and Proposed
	Sheath Limitations		
	Emergency Ratings		

ous failure, the chances are that the unit could operate for a long time without trouble, and in this instance it might be expedient to forgo this particular maintenance operation.

This whole problem of distribution in wartime was considered in detail in a symposium of papers presented at the winter convention of the American Institute of Electrical Engineers in New York recently. In this group of papers the subject, after a brief introduction by Philip Sporn, was divided into four parts, as follows:

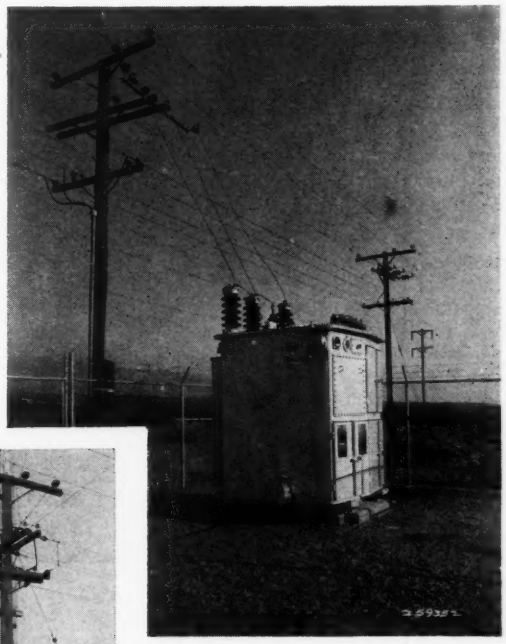
1. Power Supply to Distribution Substations in Wartime by H. P. St. Clair, American Gas & Electric Service Corp.
2. Distribution Substations and Wartime Necessities by F. C. Poage and M. W. Reid, Ebasco Services, Inc.
3. Underground Distribution Systems in Wartime by L. R. Gaty, Philadelphia Electric Co.
4. Overhead Distribution Systems in Wartime by Harold Cole, The Detroit Edison Co.

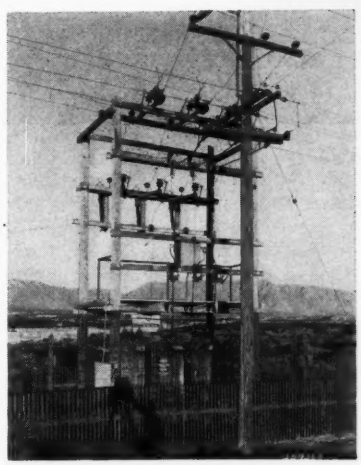
To indicate the complexity of the problem and at the same time to aid in presenting the substance of these four papers here, the accompanying tabulation outlining the subject matter of these papers was compiled. This tabulation is interesting in that it shows how each author attacked the problem differently although they were all discussing essentially the same things. It is obvious also that what was said about one phase of the subject applies equally well to the others. Thus, Mr. Cole's discussion of critical materials involved, in connection with overhead systems, also applies to underground systems covered by Mr. Gaty. Similarly, the topic, "Increased Loading of Existing Facilities" covered by Mr. Cole is touched upon by Poage and Reid under "More Use of Existing Equipment" and, of course, also applies to the two other divisions of the subject. It may be well to keep this inter-relationship in mind in this consideration of the symposium as a whole.

POWER SUPPLY TO SUBSTATIONS

THE TRANSMISSION substation is the beginning of the distribution system since such substations furnish the supply to the subtransmission lines, which in turn supply the distribution substations. The importance of transmission substations in relation to the present emergency is great because, with the exception of generating facilities, they are more likely to become bottlenecks than any other element of the system. It is, therefore, particularly desirable to explore the possibilities of getting more capacity from existing equipment in these substations.

First in importance here perhaps is the problem of obtaining greater capacity from transformers. While this problem is in many respects the same whether the transformers are in a transmission substation or in a distribution substation, there are some essential differences. The transmission transformers, for example, are usually of much larger capacity, hence there is less possibility of shuffling them around from one substation to another as is often done to advantage with distribution substation transformers.





Figs. 1 and 2. Showing the application of a new unit type substation. At the right is the new streamlined substation at El Paso, Texas, which replaces the haywire type of substation shown below. The new unit is rated at 750 kv-a. compared to the 300 kv-a. supplied by the old. Primary and secondary voltages are 23,900 and 4160. (Photo, Westinghouse)

On existing self-cooled units it is possible, in practically all cases, to obtain an increase of 25 per cent to 33⅓ per cent in capacity by the application of fans or blowers for forced air cooling. On self-cooled units not originally designed for such forced-air cooling, the application of fans must include a check on the current-carrying capacity of leads, bushings, etc. In extreme emergencies even a large portable fan could be used to obtain a quick capacity increase.

In the case of self-cooled transformers already equipped with forced-air cooling, and for water-cooled transformers, an increase in capacity can be obtained by forced oil circulation with external coolers or radiators. In extreme cases these radiators could be cooled by refrigeration. The use of a water spray also might be found of value, particularly in hot weather. While this does not offer a large increase in capacity, it is inexpensive and can be quickly applied where needed.

The use of car-mounted transformers is something that should not be overlooked. Units of this kind for use in emergency have been designed and mounted on special railroad cars. These can be equipped with a large number of tap and phasing combinations to cover practically all of the transmission substation requirements on a particular system.

Switching Equipment

In many instances the growth of systems far in excess of expectations has imposed upon circuit breakers duties considerably in excess of their designed capacities.

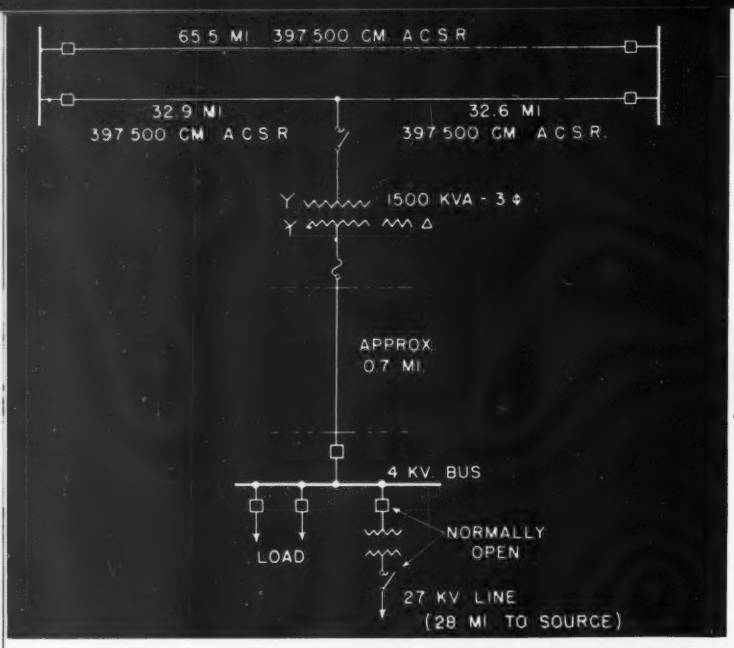


Fig. 3. Small capacity transformer tapped to 132 kv. transmission line with minimum protection

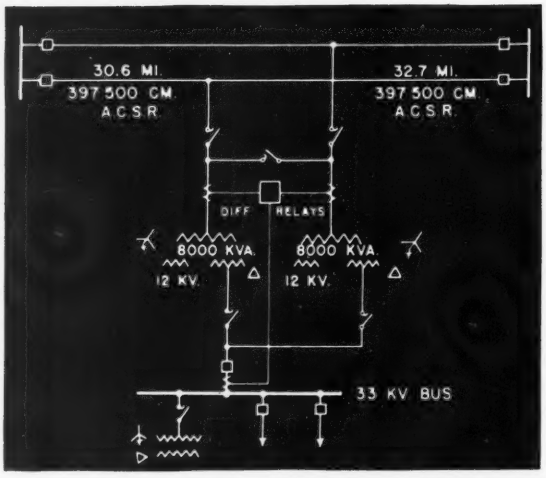


Fig. 4. Medium capacity 3-phase transformers tapped to transmission line with automatic air break switches

This is true not only in all types of substations but on all other parts of the system as well. The most economical solution, where it is applicable, is the rebuilding or modernizing of the breakers. A second solution, which in many cases may permit the necessary expansion of the station and at the same time hold down the interrupting duty on the circuit breakers is to split the bus into two or more sections. A third, and perhaps final, alternative is to install new and higher capacity breakers where the existing breakers are hopelessly inadequate. This, of course, saves neither cost nor material, but it may be possible to use the existing breaker at other locations for which new circuit breakers would have to be purchased.

It has generally been believed in the past that important transmission lines should be used only to carry large blocks of power and that such lines should not be tapped to supply relatively small loads because of the additional hazard imposed on the transmission lines. The economies made possible by occasionally tapping transmission lines with a relatively inexpensive step-down transformation have been so great, however, that more and more installations have been made. Experiences with these installations and the development of methods for installing and protecting them as well as the transmission lines themselves have brought this practice to the point where it is now considered a very practical and successful means of providing service at many suitable locations. If a transmission line is available near the desired location, a tap on the line may be the logical and economical means of supplying loads directly. The alternative means of supplying a load by extending and reinforcing the transmission system may be much more expensive both in material and labor.

Figure 3 shows a typical installation of a small 1500 kv-a. 3-phase transformer tapped to a 132-kv. transmission line. For larger stations and loads more elaborate protective equipment is justified, although not at the expense of high tension circuit breakers. Figure 4 shows a typical medium capacity station with automatic air break switch protection for the high side and with a differential relay scheme for clearing the transformers in case of trouble. A still larger station with the most complete automatic protection obtainable without using high voltage circuit breakers is shown in Fig. 5.

For lines that are relatively short with respect to the amount of power and voltage, the capacity limitation may be almost entirely a matter of the thermal limits of the conductors themselves, rather than limits due to voltage regulation. In many cases both of these limitations must be taken into account. Typical ways of obtaining capacity increases are available.

Where several circuits with conductors of moderate size are already operated in parallel, the most economical and efficient method of obtaining an increase in capacity may be the rebuilding of such lines with a considerably larger conductor, on the assumption, of course, that the existing conductor can be salvaged for needed use elsewhere. If the use of larger conductors alone is insufficient to provide the needed increase, it may become necessary to construct additional circuits which, because of right-of-way difficulties, will usually be at least as long if not longer than the existing circuits. In such an event, the use of a larger conductor on the new circuit will be of little advantage unless the conductors on the original circuits are enlarged at the same time.

As an illustration, Fig. 6 shows a typical case of three parallel 22-kv. lines serving a 24,000 kw. steel mill load. The reactors in these feeder circuits were originally installed to limit the interrupting duty imposed on the feeder breakers. Two steps of increased capacity were required, first about a 50 per cent increase to a load of 36,000 kw., and later an increase to more than double or approximately 70,000 kw. In carrying out these steps the procedure outlined above was actually reversed because of the presence of reactors in the original feeder circuits. Fig. 7, therefore,

shows the first step which consisted of building a new circuit of 350,000 cm. copper to operate without any reactor and in parallel with the three existing circuits. The final arrangement of the set-up to increase the capacity to 70,000 kw. was then obtained as shown in Fig. 8. Here the reactors in the original three circuits were removed, new circuit breakers of adequate interrupting capacity were installed, and the existing 4/0 copper line conductors were replaced with 400,000 cm. copper.

Figure 9 shows a typical instance where one 2/0 copper double circuited line constituted a bottleneck when operated in parallel with other circuits of larger conductor size. Here the installation of a reactor in the 2/0 copper circuits eliminated the bottleneck and allowed all of the circuits to carry load commensurate with their actual thermal limitations.

DISTRIBUTION SUBSTATIONS

MANY of the methods for making more intensive use of existing equipment suggested in the foregoing discussion on the power supply to distribution substations also apply to the equipment in the distribution substations themselves. This is especially true of transformers.

Voltage regulator loadings may be increased in precisely the same way as for transformer loadings, except that in step-type regulators, the tap-changing switching equipment must be considered. In some instances, induction-type regulators having series parallel windings can be doubled in current carrying capacity by connecting the windings in parallel, but at a sacrifice of half the range of regulation obtainable when operated in series. This, often, will entail no hardship if the bus voltage is adjusted on a scheduled cycle.

Increases in circuit breaker current carrying capacities can be obtained in some instances through silver plating of the contacts and bushing studs. Switching arrangements can be adopted which place two circuit breakers in parallel but care must be taken that the impedances of parallel leads are equal.

Where the fault current has been increased by increasing transformer capacity to a point where it exceeds the interrupting capacity of the circuit breakers the main bus may be split into two or more sections as already pointed out. This method introduces an element of inflexibility into the operation of the substation, but it may be the only practicable solution to meet the situation. Another solution is to arrange to trip one or more of the transformer breakers or a bus-sectionalizing breaker a few cycles ahead of the feeder breakers in cases of high current faults, thereby reducing the current to be interrupted by the feeder breakers.

Reactors are of advantage in reducing possible fault currents. They may be inserted between bus sections normally fed from different transformer banks. Where

"He wants us to grant him, as watchman, power of Dictator during blackouts"

bus sectionalizing is not possible series reactors may be inserted in the supply circuits. Such reactors will introduce additional regulation and losses in the supply circuits. This effect, where objectionable, may be overcome by normally short circuiting the reactors through breakers or fuses co-ordinated with the time characteristics and interrupting capabilities of the feeder breakers.

Practice Regarding Other Equipment

Air break switches and disconnects may have their capacities increased by silvering the contact areas. In some cases the contact pressure can be increased by the use of clamps over the jaw contacts.

Forced ventilation of cable tunnels, manholes and duct lines may be required to reduce ambient temperatures and thus increase the capacity of cable circuits.

Buses and equipment leads are usually of ample current carrying capacity without exceeding the usually accepted temperature rise of 30 deg. C., but this rise may be materially exceeded without deleterious effects on buses, leads or equipment attached to them. Increases of current in the bus of the order of 20 per cent above the limit fixed by the present standards seldom will raise the bus temperature more than an additional 10 deg. C. Higher operating temperatures may require additional provision for expansion.

Economies and Conservation in New Work

In planning new construction initial orders should cover the full requirements of the work. Priority restrictions being what they are, to run short of materials needed to finish construction may seriously postpone operation of the facilities. Structural steel may be saved by simpler layouts. In the case of bus structures, wood may be used in place of steel.

Many of the plants producing material for war provide for power supply to at least half of the load from each of two sources, including separate substations. The practice of providing transfer bus, inspection bus or other duplicate bus arrangements for new distribution substations should be abandoned for the duration.

For high-voltage, moderate current bus bars and connections structural steel shapes or steel pipe may be substituted for copper tubing. It may become necessary to use copper cable as bus in lieu of copper tubing or bar. Silver and silver plated steel tubing is being used in some cases.

Fuses can be substituted for high side circuit breakers in substations of simple layout. One precaution may be needed, that is, phase-failure relays may be needed to open the low side breakers to prevent damage to customers' polyphase equipment in case the supply to the high voltage side is single-phase due to the blowing of one fuse.

Equipment should be inspected more frequently and maintained at

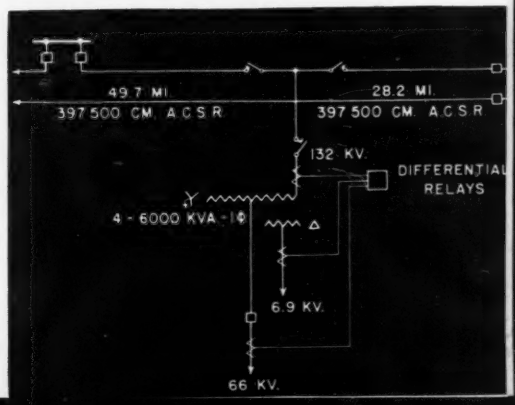


Fig. 5. Large capacity transformer bank tapped to transmission line with automatic line sectionalizing

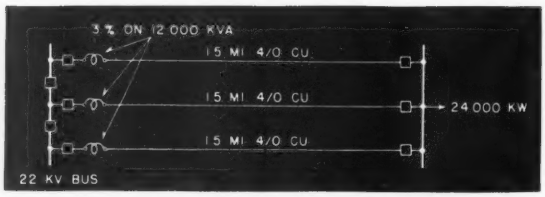


Fig. 6. Original layout for 24,000-kw. load

a higher degree of precise operating condition than has in many cases, heretofore, been considered adequate. The need for ever minor repairs or replacements should receive immediate attention. Fire protection should be given increased consideration. Probably the most economical and effective protection available at this time against fires resulting from oil ignition in outdoor substations is obtained from water sprays apparatus. Where water is not available dry compound apparatus is quite satisfactory, as are carbon dioxide extinguishing devices. Foam is effective in fighting oil fires, but its use around electrical equipment is open to objection because of the work required to remove the caked foam after the fire is out.

OVERHEAD DISTRIBUTION SYSTEMS

IN OVERHEAD as well as underground distribution work and, of course, in all other work, the most effective way to save material is, not to use it. In the building of such new lines as are permitted, every effort should be made to keep the material used to a minimum. The size of wire used should be the minimum to give reasonably satisfactory service to the initial customers unless increased loads are known to be coming in the immediate future. Under present conditions this practice is justified even if it may require changing to a larger size a few years hence.

It may also be possible to justify some modifications of the pole layout so as to conserve material. Temporary short-cut routings of line extensions may be resorted to in some cases to reduce the length of line required. The use of longer spans in the initial stages of residential development will conserve poles, cross-arms, hardware and insulators.

Increased Loading of Existing Facilities

The elements discussed in regard to increased loadings of existing facilities in connection with the other divisions of the general subject apply with equal import to overhead distribution lines. Conditions are different, however. With respect to the increased loadings of overhead lines, for example, the heating of overhead conductors is greatly affected by air movement and yet the limiting ratings are often based on temperature rises in still air with high ambient temperatures. As there is practically always some air movement past conductors in overhead line construction, the effect is to materially reduce the actual temperature rise.

In the case of distribution transformers it is not possible to increase the capacities by the methods outlined for large units, but the modern distribution transformer is inherently capable of handling considerable overloads for short periods. With any one of several methods of determining transformer peak loads, it will be conservative to allow estimated winter peaks of the order of 150 per cent of name plate rating. Before materially loading transformers beyond this point, it is important to have adequate information on load characteristics and values, as a large number of damaged transformers on a system would be a serious detriment to good service in later years.

Excessive voltage drop will probably be a more frequent cause for system reinforcement than current limitations. Here, again, it would seem that the accepted good practice could be modified somewhat during the war period. When, in the face of serious material shortages, economics are no longer the ruling consideration it would seem that standards of voltage regulation which apparently are giving satisfactory service to the farmers should not be too poor for the city dweller to put up with during the war period.

In spite of increased current ratings and more liberal voltage limitations, the time will be reached, as loads increase, when something will have to be done to bolster up the supply. This, however, need not always take the form of adding new facilities or replacing old ones with a like kind of larger capacity. One of the most promising expedients which is available, not only to improve voltage regulation on distribution lines but to decrease the line current capacity for the same load, is the use of shunt capacitors to improve the power factor of the load. An extensive use of this device has been justified under the normal economic conditions of the past few years, and they offer a very effective means of conserving vital material under present conditions. It is true that they require for their construction an appreciable amount of aluminum foil, but the amount of copper which could be saved by their intelligent use should recommend them very highly to the authorities having to do with the allocation of all of these materials.

Another very economical expedient available to improve the regulation of long rural circuits is to use the line-type voltage regulators or step-voltage boosters. Standard distribution transformers, if they have the proper turn ratio, may be used very effectively as boosters to produce a better range of voltage in a circuit at low cost.

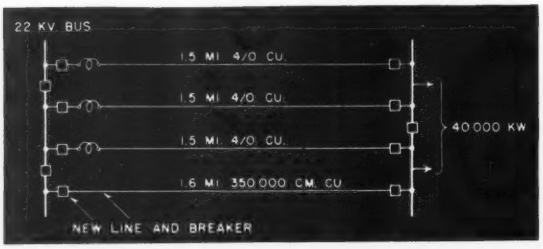


Fig. 7. First step to increase capacity of lines to serve 40,000-kw. load

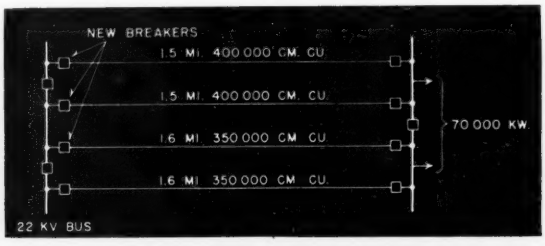


Fig. 8. Final layout to serve 70,000-kw. load

In any well engineered electrical distribution system there will always be an appreciable amount of wire and equipment which will be capable of carrying much greater loads than they are carrying. It may be desirable to do a certain amount of rearrangement of these materials under the present circumstances so as to use them more effectively.

It is possible to replace larger sizes of wire with smaller in locations where the load has not yet developed and to transfer this larger wire to locations where the load is increasing rapidly. In some instances it may be possible to remove wire which is not required to maintain service except in case of failure of some other source of supply. This may lower the standard of reliability, but under present conditions this may be justified.

In addition to conserving new materials for line construction, a great deal can be done toward the same end by the maximum use of material removed from the lines. Highly profitable salvage operations have already been organized in a number of companies for this purpose, and it is imperative that the practice be adopted by all operating utilities.

Salvage operations which are most productive in the conservation of line material are the following:

1. Cleaning, straightening and splicing together into standard lengths all wire suitable for reinstallation.
2. Removing weatherproof covering from wires not suitable for reinstallation and splicing in lengths suitable for recovering or use as bare wire.
3. Cutting up very short lengths for use as tie wires, ground rod, pigtails, etc.
4. Reconditioning hardware, fuse carriers, lightning arresters, and all articles of line equipment not hopelessly obsolete.
5. Cutting off rotted sections of poles and retreating them for use as shorter poles or guy stubs.

UNDERGROUND DISTRIBUTION SYSTEMS

IN UNDERGROUND distribution systems where radial distribution is used advantage may be gained, both in capacity and in regulation, by changing to a network system. A properly designed network will increase the capacity of existing facilities in a given area and improve the service reliability. If maximum use is made of the capacity increase there will be very little voltage improvement. Here, also, however, it may be necessary for us to modify our existing concepts of satisfactory voltage regulation in order to make available the maximum capacity to carry the load.

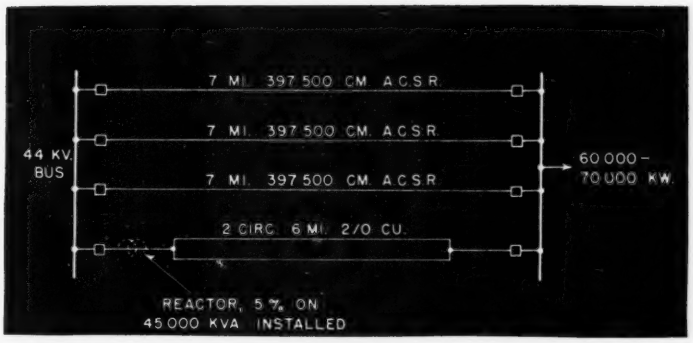

7 MI. 397 500 CM. A.C.S.R.
7 MI. 397 500 CM. A.C.S.R.
44 KV. BUS
7 MI. 397 500 CM. A.C.S.R.
60 000 – 70 000 KW.
2 CIRC. 6 MI. 2/0 CU.
REACTOR, 5 % ON 45 000 KVA INSTALLED

Fig. 9. Unequal impedances of lines in parallel resulting in bottlenecks

Additional capacity also may be made available by parallel operation of primary feeders. This must be done with care so that a large area will not be without feeder service in case of a cable failure. The same advantage may be gained by transferring customers between feeders in order to obtain the highest load factor.

Reliability of Supply

It is only common sense to take all reasonable precautions to guard both underground and overhead systems from damage, intentional or otherwise. What was stated above in connection with substations in regard to fire fighting equipment applies also to the distribution equipment. For quick action fire fighting equipment mounted on a truck or trailer should be provided for use on any part of the system. Such equipment is useful not only in fighting manhole and vault fires but also for other types of fires on the system. Fireproofing of cables in manholes and vaults should be very liberally applied to minimize the danger of a fault being communicated to adjacent cables and to reduce the damage which will result from a manhole or vault fire.

Spare material should be watched to insure an adequate supply for any reasonable emergency. Fault locating equipment should be checked and kept available for instant use. Repairs should be made as quickly as possible. Temporary repairs which have to be remade later on are usually not justified. This has been verified by incomplete reports from England. Some experiments have been made with a "cold setting" material for making a temporary high voltage cable joint which does not require a lead wipe. This has been found to be practical and usable where conditions require it, but in most instances it is better to make permanent repairs.

A considerable amount of research work has been done on the underground system in order to determine the limitations of the equipment used. Cables, ducts, manholes, transformers, and cable accessories have been studied and related to each other and to the ratings that may be used with safety.

Circuit capacity may be limited by apparatus in the circuit, such as switches. Transformers and transformer vaults may be a limitation either on a radial or network system. Improvements in ventilation of vaults may increase capacity in a number of ways.

Insulation deterioration is not a serious problem with modern distribution cables operated at temperatures well above the A.I.E.E. temperature rule. Temperature variation rather than temperature level causes the major damage to the cable by causing sheath deterioration. Small cables have less cable movement for the same temperature variation than large cables. Cable conditions can be materially improved by using three single conductor cables of the same copper cross section in place of one three conductor cable.

In concluding this discussion of the operation of electrical distribution in war time it is necessary to point out that in most cases we have, here, only indicated the procedure which might be followed. The problems involved are such as to require our best engineering talent and the substance of all our previous experience. We may have to revise our ideas of what constitutes good practice in some cases, but it is still necessary to provide absolutely the best possible service consistent with the severe limitations under which it is necessary to operate.

EMERGENCY POWER

Despite the large power generating facilities for the nation as a whole, there are bound to be instances where, because of new war industries, local shortages will develop. What can be done to meet such conditions? This article discusses some of the possibilities as well as actual plans that have been made to supply emergency power requirements

THE PROBLEM confronting the power engineer in providing war industries with an adequate supply of power under all conditions is not so much one of lack of raw material as it is lack of plant to turn the raw material into power. There is ample coal and oil and there is still a great deal of undeveloped water power which could be developed even if it might not be the best economy to do so. Despite the fact that we have in this country an installed capacity of some 50,000,000 kw. and that we expect to install an additional 3,000,000 kw. this year, the chances are that we will not have any too much capacity to meet our needs.

Barring accidents or unfavorable water conditions we can probably get by as far as the nation as a whole is concerned, but there are bound to be instances where, because of new war industries, local power shortages will develop. By the use of intelligent planning and with proper foresight the location of new war industries can be made in regions where there are ample power reserves, but this is not always possible.

Fig. 1. Three steam locomotives supplying steam to a plant in which the boilers had to be shut down for a period of 12 days.

The construction of a power plant of this type to supply a new industrial plant is only one phase of the emergency power problem. There are likely to be many cases where temporary power shortages may develop and which could be met by the use of some sort of mobile plant. In other cases of such temporary shortage of power but where there might be access to a power transmission line, the situation could be met by a mobile substation of mobile transformer bank. A still different situation might prevail where, because of increased inductive loads, the capacity of a transmission line or power system is limited by excessive reactive current, at least for a period of time. In such cases, a solution can be effected by the use of portable capacitor installations. A number of such units have been built for use by various public utility companies and they have proved very useful.

Where temporary steam capacity is needed, to supply an unexpected temporary peak load or during the time of a boiler repair, a possible solution lies in the use of railway locomotives. This is probably a crude solution, but in times of emergency one cannot afford to be choosy and the use of locomotives offers a way out. A case of this kind was reported not long ago when the St. Louis Terminal Railroad Association found itself confronted with such a problem. While relining a large stack at their 18th St. station it was necessary to shut down their boiler plant. After much consideration they decided to utilize three yard-type locomotives to furnish the necessary steam. It required a 12-day shut-down to reline the stack, and the locomotives furnished the steam without any difficulty. No data was available in regard to the efficiency of locomotives used in this manner and so the engineers included test instruments such as a water flow meter, steam flow meter, draft gages, temperature instruments and orsats in the setup. The results obtained were very interesting. An overall average efficiency of 74 per cent was obtained, and the peak demand required was 35,000 lb. of steam per hr., at a steam pressure of 155 lb. per sq. in. From orsat tests made each 15 min. regardless of firing conditions, an average of 10.2 per cent CO_2 was obtained.

This particular case provides sufficient evidence that the suggestion of impressing locomotives into service is not entirely imaginary. It has been done and in view of the unexpected and unusual situations that may arise during these times it may prove valuable again.

Floating Power Plants

Mobile power plants can be divided into two groups, those mounted on trucks or railway cars and those mounted on ships or barges. The latter can, of course,

be made in much larger capacities than the wheel mounted type.

Anticipating the need for greater flexibility in the National power supply the Government plans to construct at those locations where from time to time the war needs are greatest, a fleet of at least four floating power plants. These plants built on barges will be able to navigate most of the inland waterway system and the Great Lakes.

As a result of several months of investigation, a definite plan has been perfected to construct—complete on a single barge—a standard 25,000-kw. unit capable of 30,000 kw. at high power factor, together with the necessary boilers, fuel tanks, and auxiliaries. These plants will have practically the same efficiency as a land plant; will cost little if anything more; can be towed to almost every important load center in the inland industrial area; and can be readily transferred from one point of emergency to another. For example, if the Southeast experiences another power shortage such as developed last summer, one or more of these plants could be tied into the interconnected systems at Mobile, New Orleans, Memphis, Louisville, Chattanooga, and at many other points. The Southwest can be assisted from Arkansas, Louisiana, or the Texas coast wherever the need is greatest. War industries in Illinois, Indiana, Ohio, and western Pennsylvania can be served from many convenient points in the Ohio and Mississippi River systems; and in most seasons of the year, help can be given in areas as far North as Minnesota and by utilizing existing transmission networks, as far West as Kansas and Nebraska. These floating power plants will be made available under temporary lease to power systems in shortage areas, and where there are competing needs, the War Production Board will determine which are the most vital.

Such floating plants should prove entirely practical and their use will not be without precedent. Even in normal times floating plants have considerable merit. As an example, the Jacona has for many years rendered effective service in the New England States. Another classic example of the use of floating plants was when the Aircraft Carrier Lexington with its 180,000-hp. power plant, was impressed into service when a temporary power shortage developed at Tacoma, Washington.

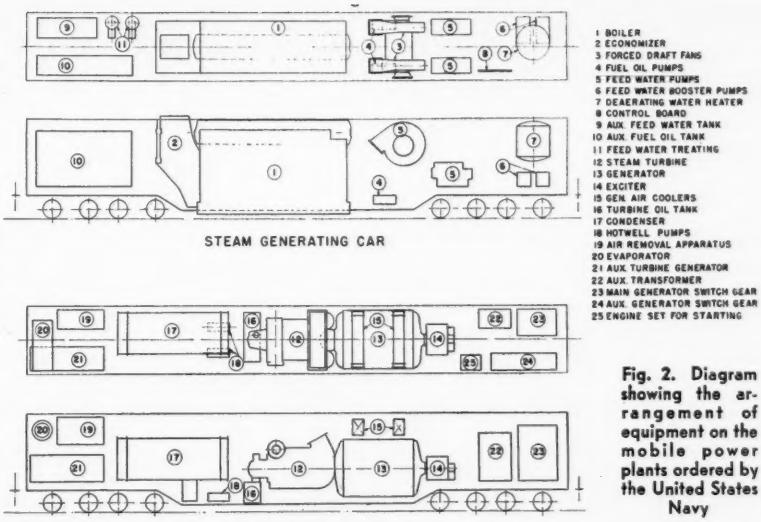


Fig. 2. Diagram showing the arrangement of equipment on the mobile power plants ordered by the United States Navy

During the wartime emergency, the added flexibility makes each kilowatt of floating power the equivalent of at least 2 kw. tied down to a permanent location.

Power Plants on Rails

Where comparatively small amounts of temporary power are needed plants mounted on trucks or rails can be made to fulfill the emergency needs. Of chief interest here are two 10,000-kw. mobile steam-electric power plants planned by the Bureau of Yards and Docks of the Navy Department as reported in The General Electric Review recently. These two plants will be mounted on special railway cars and will be designed so that they can be moved to any of the Bureau's projects as required. It is planned to locate one of these units in the east and the other in the west.

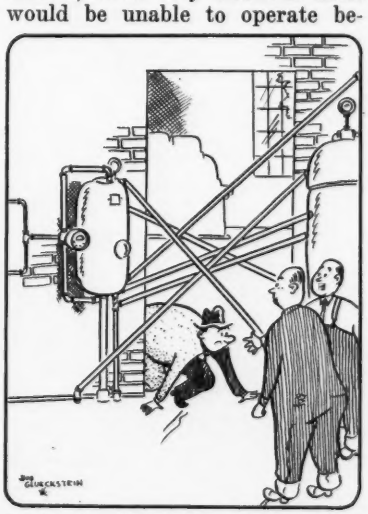
Each power plant will be housed in two specially built railway cars with the power equipment arranged as shown in Fig. 2. The boiler and its auxiliaries, and a starting engine generating set will have one car; the turbine generator and its accessories, a condenser and switch gear will have the second. A mobile substation constructed on a standard car will also be used to permit the proper voltage to be obtained for any Naval Shore Establishment.

Each unit will furnish 140,000 lb. of steam per hr. The single-cylinder turbines will use 550 lb., 825 deg. F. steam. The 3600-r.p.m. generators will produce 60 cycle, 3-phase, 13,800 v. power, and will be forced air cooled.

Mobile Plants For Emergency Starting

The mobile plants described in the foregoing are intended to supply actual loads over a considerable period of time. There are occasions where a portable plant might be called upon merely to assist in starting up an existing steam station and in such cases less elaborate equipment would suffice.

In the case of a utility plant, normally interconnected with other generating stations on a system, and designed with all electrically driven auxiliaries, if, as a result of a bombing raid, such a station was shut down and isolated from the rest of the system, it would have no way of starting up again. Since the boiler feed pumps as well as all the condenser auxiliaries would be driven by motors, these very essential units would be unable to operate be-



"Well—these short-cuts save a lot of copper tubing!"

cause of a lack of electrical supply.

In such cases if a small mobile plant were available to supply this electrical energy for a short time, there would be no difficulty in starting up. For such occasions it might be possible to use a Diesel-electric generating unit mounted on a truck. It might even be possible to utilize one of the many streamlined Diesel locomotives in this country. These locomotives are in reality Diesel-electric power plants supplying electric power to electric motors and it might be possible to use the output to serve an emergency stationary load. There may be reasons why this would not be feasible, but the possibility should be considered in any consideration of emergency power supply.

Packaged Power Systems For Air Bases

Where power supply systems have to be furnished quickly and for specific types of service, the General Electric Co. has designed so-called "packaged" electric power systems. These have been developed especially for air bases, but of course, have other applications as well. Planned as units, these systems have all their parts, generating equipment, load-center power units, unit substations, distribution transformers, and switchgear, co-ordinated electrically, mechanically, and thermally in advance of installation.

Experience indicates that the time normally required for designing and building a conventional system can be reduced from 4 to 8 mo. through the use of these packaged units.

To assure reliable functioning under warfare conditions, the systems are designed so that power continues to be supplied to unharmed parts even after one area has been damaged. All apparatus in the systems are metal-enclosed for protection, safety, and reliability. Each of the systems includes two or more regular sources of power supply; using tie-ins with outside generating facilities wherever available. As shown in the diagram of one of these systems in Fig. 3 there is provision for a mobile power unit.

As already mentioned a number of mobile substations have been built by various public utility companies for use in relieving substations which because of war industry loads may be called upon to carry more than their rated loads. Such mobile units can be used to carry the entire load of the substation while its capacity is increased by the installation of new equipment or they may be used to carry a part of the load indefinitely.

Portable Substations vs. Spare Parts

While portable substations have definite advantages in that the complete assembly of equipment is ready for instant use, some engineers are of the opinion that, in this period of emergency, it is more desirable to have on hand separate units of spare equipment. Portable substations, they contend, must be used as an entity and cannot be separated so that each component part can operate apart from the others. According to this view, with spare equipment at a premium, it would seem to be the better policy to have spare units of equipment so that these units can be used at different locations as needed. For example, a spare transformer can be used in one substation and at the same time, a spare circuit breaker used for emergency service at a second substation.

Naturally, this question as to the relative advantages of portable substations vs. spare parts is one which has no general answer. The use of one or the other depends entirely upon local conditions. In cases where an ample stock of spare parts is available a portable substation will have decided advantages. In other cases spare units of reserve equipment probably offer a greater degree of protection in having a wider diversity of use although the time element for restoring service in an emergency will be in favor of the portable substation.

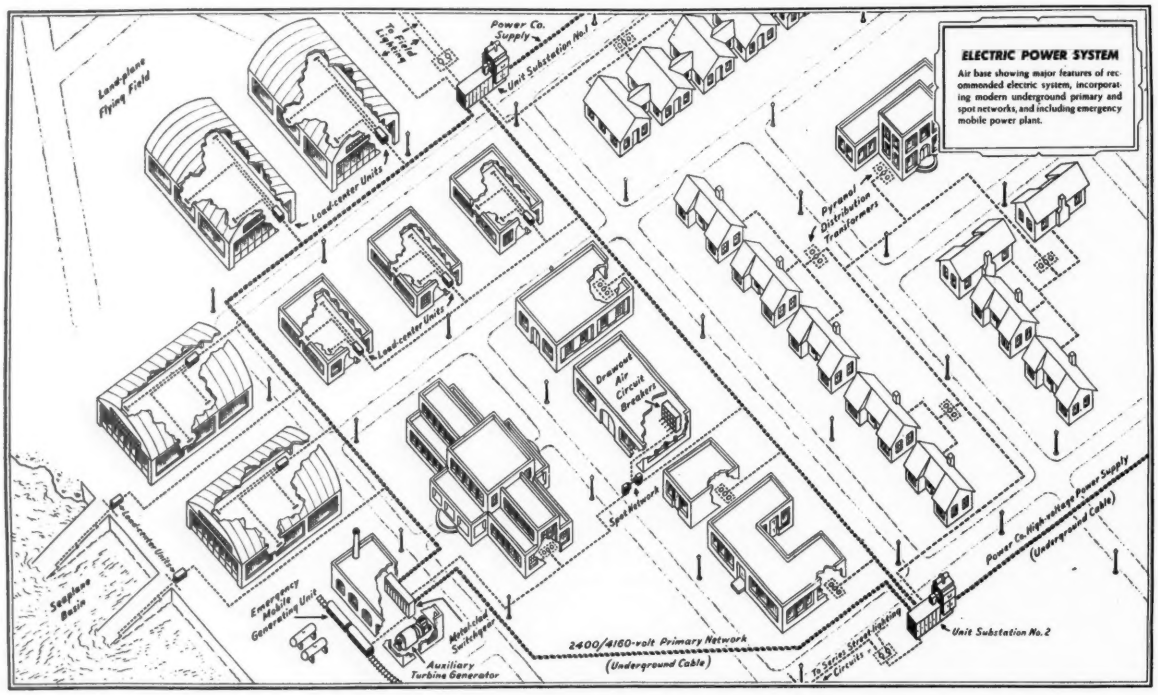

ELECTRIC POWER SYSTEM
Air base showing major features of recommended electric system, incorporating modern underground primary and spot networks, and including emergency mobile power plant.
Power Co. Supply
Unit Substation No. 1
To Field Lighting
Landplane Flying Field
Load-center Units
Pyranol Distribution Transformers
Drawout Air Circuit Breakers
Spot Network
Power Co. High-voltage Power Supply (Underground Cable)
Seaplane Basin
Emergency Mobile Generating Unit
Metal-clad Switchgear
Auxiliary Turbine Generator
2400/4160-volt Primary Network (Underground Cable)
To Secondary Street-lighting Circuits
Unit Substation No. 2

Fig. 3. Isometric sketch of an electric power system for an air base

Now that we are engaged in a "shooting" war, what steps must we take in the construction of new power facilities and in the protection of new and existing power facilities? Bombs may never be dropped on our American cities in large numbers, but we must be prepared for such bombings whether they materialize or not. In this article Mr. Starr discusses the general plan of procedure we must take. Based on a knowledge of what has happened in England, Mr. Starr's analysis of the situation should be of considerable value to engineers in this country whose responsibility it is to keep the supply of power flowing

Building and Protecting Power Systems in Wartime

By F. M. STARR
Central Station Engineering Dept.
General Electric Co.
Schenectady, N. Y.

IN THE FEB. 13, 1941 Public Utilities Fortnightly, Herbert Corey writes:

"For 5 mo. the military authorities, representatives of the various utilities, and heads of the various government bureaus, have been considering this question:

"How can the utilities be protected if this country goes to war?

"It is probable that not one of the men engaged in this inquiry believes in his heart that there is even a remote possibility that the U. S. will get into a 'shooting' war. But the fact remains that the foreign policy association—responsible and not emotional—has stated that while it is highly improbable, it is not wholly inconceivable that we may be forced in either of our own will or through irresistible circumstances."

Less than a year later we find ourselves in a "shooting" war and can be thankful that planning for the eventuality of wartime operation had started as early as it did.

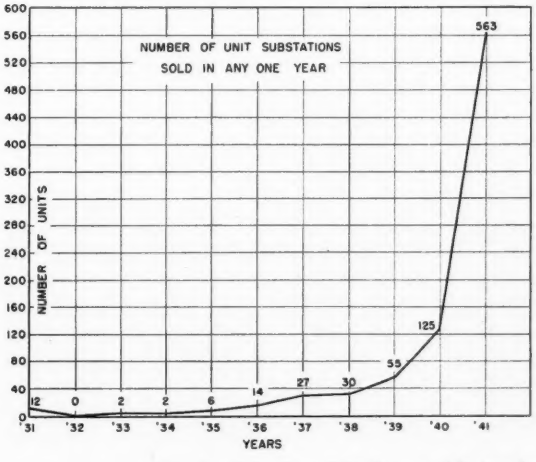
What are the principle problems of the electric power utility?

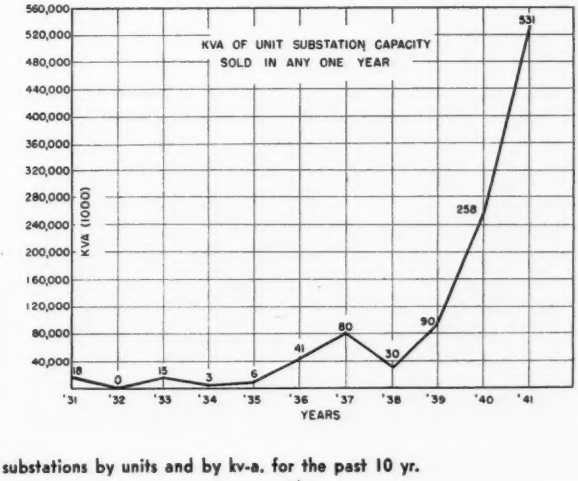
1. Maintenance of adequate power supply, voltage, and continuity under conditions of rapidly growing loads.
2. Protection against sabotage.
3. Protection against aerial bombardment.
4. Doing all of these with the minimum amount of man-hours and materials.

The solutions to these problems, obviously are not 100 per cent compatible. For example, the best protection may not be practical because of material or labor shortages. The solution must be what we might call an optimum compromise.

Maintenance of Adequate Power Supply to Growing Loads

It is not the purpose of this article to elaborate the many ramifications of maintaining adequate power supply, but rather to emphasize several fundamentals which must be adhered to.





Figs. 1 and 2. Growth in the use of factory built substations by units and by kv-a. for the past 10 yr.

Much of the new load to be supplied by our utilities consists of cantonments, air bases, naval bases, and many varieties of vital industrial plants. These have required much new distribution equipment and have called for it in a hurry. As a result we find greatly accentuated, a trend which started several years ago. This is the increase in the use of completely factory-built switchgear assemblies and distribution of substations. The reasons for this trend are:

1. Factory-built and assembled equipment can be standardized for the whole industry.

2. Because of standardization lower cost equipment is made possible.

3. Because of standardization, and the repetitive process of manufacture, higher quality can be obtained.

4. Standardized factory-built equipment can be built and installed in much less overall time.

The first completely factory-built substation was built 10 yr. ago. Last year 563 units were installed, totaling 531,000 kv-a. Figures 1 and 2 show the growth in these applications by units and kv-a. for the past 10 yr. Figures 3 and 4 show typical outdoor and indoor units respectively. Many of these standardized equipments are now serving power to our Army, Navy and industrial projects. The availability of standard equipments of this type has greatly speeded war production. The fundamental to be learned and emphasized here is that speedy expansions can be obtained by designing our distribution system only with a multiplicity of small standardized units. This principle applies in general to the rest of the power system as well as distribution.

As will be pointed out later this same principle has an important bearing on protection against sabotage and bombardment.

As many believed a year ago that there was only a remote possibility of this country getting into a "shooting" war, so many believe today that there is only a remote possibility of any bombs dropping on our American cities. Remote or not, if bombs do drop protection must be planned in advance. And certainly our power supply systems deserve the first consideration, for if we lose our power we stand to lose everything.

Protection Against Aerial Bombardment

Consider first what bombs are and what they do.

Our utility systems are targets for both incendiary bombs as well as high explosive bombs. Most incendiary bombs used today are made of thermite or magnesium, weigh about 2 pounds, and are dropped in quantities over wide areas to start as many simultaneous fires as possible. They can penetrate conventional roofs and burn viciously for 15 to 20 min. wherever they come to rest. Most electric power plants and distribution systems are not very vulnerable to incendiaries unless accompanied by high explosive bombs to disrupt and open oil-insulated equipment.

High explosive bombs are highly destructive because of (1) their power to penetrate massive structures and substantial depths of both earth and concrete; (2) the terrific blast which follows detonation; (3) the high-speed pressure waves which emanate in all surrounding media; (4) the dispersion of hundreds of small steel bomb-shell fragments at high velocities.

General purpose bombs weigh up to about 600 lb., but the larger demolition bombs weigh up to about 6000 lb.

A 4000-lb. bomb, exploding after embedding itself in the earth, would produce a crater 30 ft. deep, serious blast effects for a radial distance of 800 ft., earth shock for distances of 300 to 400 ft., and the possibility of damage from flying fragments for distances up to ½ mi.

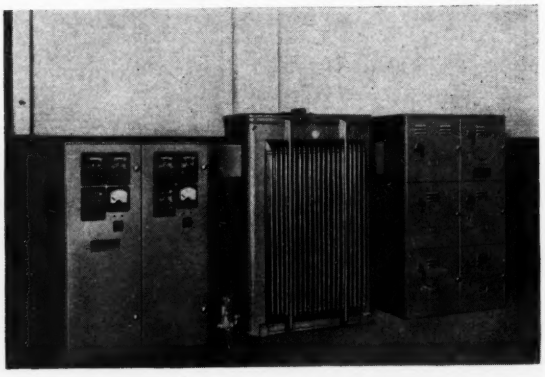
These facts serve to emphasize one principle of system design—namely, anything which is absolutely invulnerable to high explosive bombs would need to be at least 50 ft. underground and surrounded by 8 to 10 ft. of solid concrete. Thus, we conclude it is impossible to make the various elements of a system invulnerable. Even to make them partially so against nearby hits would require enormous amounts of materials in the form of baffles, barriers, etc.

It has frequently been proposed that substations be placed underground for protection. There is no doubt that underground installations would lessen their vulnerability. Right now, however, except at very strategic locations, underground substations are impractical. Because they would need to be designed to operate submerged in water and because they are otherwise special in nature, the man-hours and materials required to build them would be prohibitive. Moreover, the time required to build them is such as to make them unadapted to our present emergency.

Experiences in Great Britain

Britain's great problem in maintaining power supply has been overcoming air-raid damage. Today, everyone gets all the power they want in Great Britain. British engineers have succeeded unusually well in solving their problem of maintaining continuous power supply. They have been able to do so by adopting a few fundamental principles of operation.

First, whenever possible, equipment has been standardized. Second, national pools of spare equipment have been established to be quickly available wherever outages



Figs. 3 and 4. Typical outdoor and indoor substations of present-day design. Their compactness lends a high degree of flexibility

and damage occur. Third, the principle of networking in all voltage classes has been adopted whenever feasible. Fourth, well-organized patrol, fire-fighting, and maintenance crews have been established. Fifth, supply power sources have been diversified as much as possible to insure against prolonged outages in the event of equipment failure.

The results of this procedure have been gratifying. Only short time outages occur. Generating plants have been hit, but no serious damage has resulted. Overhead conductors have been cut by flying bomb fragments, but are always quickly repaired. Few wooden poles have been overturned and few steel towers have been seriously damaged. Porcelain insulators, though frequently chipped, stand up unusually well. Underground cables likewise have stood up well even when subjected to direct hits.

Even though the underground systems have stood up remarkably well, on new construction, overhead lines are favored somewhat because of the speed with which they can be repaired.

It is significant that the British engineers have made no attempt to make their power systems invulnerable. They have used concrete and sand-bag barriers only to a limited extent. Flashy protective gadgetry is notably absent. Rather than attempt to make the power supply invulnerable to air raids, they have so diversified it and so operated their supply system that the loss of any part of it does not hurt much.

Vulnerability to Sabotage

Protection against sabotage has been a minor problem in Great Britain compared to that of protection against bombardment. Sabotage here is likely to be much more of a problem—in fact, already is.

The solution in this case is fairly obvious. Important loads should be served by at least two circuits from different sources. Substations should be metal-enclosed with no exposed live parts, and should be off the highway. Preferably, there should be two substations in this case.

The principle of diversity of supply is equally important in protection against sabotage as against aerial bombardment.

Many automatic alarm systems have been proposed for substations, power plants, etc., to give warning of the approach of the saboteur. Most of these are impractical because they require considerable maintenance and give too many false alarms. Typical of such schemes is the "electric eye". In general, the use of gadgetry cannot be depended upon for protection.

Fig. 5. Adequate lighting of yards and property boundaries is important. Here a group of engineers are inspecting protective fence lighting

Probably the best protection is afforded by a well organized and well trained patrol such as those which are now functioning on many of our large power systems. Typical of such systems is the one in Chicago. Here the entire property of the Commonwealth Edison Co. is patrolled continuously by several hundred well trained guards. Equipped with nearly one hundred patrol cars, these men, deputized by the Chicago Police Dept., are in continuous radio communication with Police Headquarters, and have proven to be very effective in protecting against sabotage.

Another effective tool in protecting against sabotage is floodlighting supplemented by armed guards or patrols. Floodlighting is widely used now on structures, entrances, and protective fences in many of our industrial plants as well as power supply plants and structures. Fig. 5 shows a typical protective floodlighting installation. Here two 1500-watt lamps are used at intervals of 300 ft.

Availability of Man-Hours and Materials

In reviewing anti-sabotage activities, one fact stands out—it is impossible to make our power systems invulnerable to sabotage. This being the case, whatever we do for protection should follow the basic principle of *getting the saboteur* rather than *preventing sabotage.*

It has been emphasized that whatever is done for protection of our power systems must be compatible with the availability of manhours and materials. It has also been noted that the means adopted for strengthening our power supply systems for new loads must be those which also give maximum conservation of manpower and materials. There are many things which can be done in this direction depending on the specific problem. Only two important ones will be elaborated here.

Undoubtedly, one of the most completely effective methods of getting the most out of our power systems and of saving inestimable quantities of materials and manhours is the application of the capacitor for power factor improvement. Attesting to this fact is the large quantity of capacitors now being purchased and applied by the utilities and their industrial customers. Roughly, one kv-a. of capacitor will release 0.3 kv-a. of thermal capacity in cables, transformers, generators, etc., and it will release, on the average, one kw. of capacity on transmission lines and overhead distribution feeders. In addition to this it reduces system power and energy losses. This possible loss reduction means that a kw. of load can be delivered with a saving in from 3 to 5 per cent in system capacity, and a kw-hr. of energy can be delivered with a saving of from 2.5 to 5 per cent in fuel or water. Of further importance is the fact that capacitor can be manufactured in a few weeks, can be installed quickly, and requires little or no maintenance.

The second item of importance in increasing our firm capacity with a minimum of materials is the use

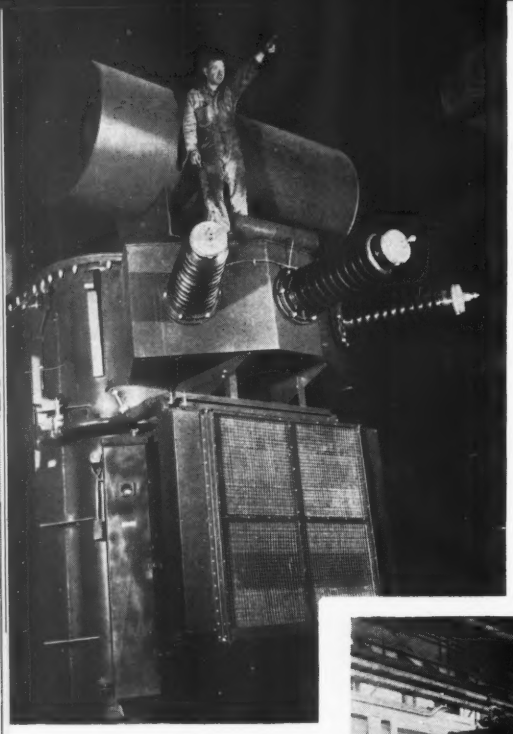


Fig. 6. One of six 15,000 kv-a. mobile power transformers which were mounted on specially designed railroad cars for quick movement to any point on the American Gas & Electric Co. system

Fig. 7. Typical 2500 kv-a. portable distribution substation similar to many now in service

and application of portable or mobile equipment. The industry is now seriously interested in portable substations, portable capacitors, and portable generators. Portable equipment is used to relieve sudden unanticipated overloads or to serve temporary loads, and it is used as reserve for equipment failures or shutdowns. This latter function is particularly important at the present time since a portable unit which can be gotten into service quickly at any of a number of points eliminates the need for much permanently installed reserve capacity. Figure 7 shows a typical 2500-kv-a. portable distribution substation similar to many now in service.

Figure 6 shows one of six 15,000-kv-a. mobile power transformers, which were mounted on specially designed railroad cars for quick movement to any point on the American Gas & Electric Co. system.

The Navy now has on order two 10,000-kw. turbine-generators complete with all auxiliaries to be mounted on railway flat cars.

Four 30,000-kw. floating power plants are being built for the War Production Board to supply power wherever emergencies or abnormal demands on existing land facilities may require it.

Summary

To summarize, let it be emphasized again that it is impossible to make our power systems invulnerable to sabotage and aerial bombardment. Even if it were possible, the present scarcity of man-hours and materials make it impractical. This being the case, the solution is to so design and operate our power supply systems such that the loss of any element constitutes a relatively small loss. *This means working toward multiplicity of small standardized units. It means standardization and simplification. It means diversification of supply.*

GETTING AROUND PRIORITIES

DESPITE the shortages in certain strategic materials the most vital shortage that confronts us in this war is the shortage of "time." This is especially true with regard to the expansion of our power producing facilities. Even before the war it took from 6 mo. to a year or more to build an ordinary large turbine and things have not changed very much in this respect. As a consequence, even where A-1 priorities are procurable, it still takes a year or more to build an average power plant and, these days, that is usually always too long. Where a power plant is needed, say, in 6 mo., it does little good to have an A-1 priority when it will take a year or more to build the turbines and boilers. In other instances, involving small equipment which could be built within the required time, the necessary priorities may not be available. In either case, it becomes expedient to use old or makeshift equipment.

In the second category, is the case of a small paper mill plant that came to our attention recently. A new power plant was needed, but the necessary priorities could not be obtained. So, it was decided to build a new plant of old equipment. Some old boilers were obtained that were still in serviceable condition, an engine long in disuse but still on the premises was rehabilitated, an old generator was found that had seen long service but was still in excellent condition, auxiliary machinery of various vintages was collected and the whole fashioned into what, when finished, proved to be a very serviceable power plant. Even the switchboard together with the bus bars was resurrected from an abandoned installation and put into shape for further use.

This is somewhat of an unusual case, but not so unusual that it cannot be duplicated in dozens of instances all over the country. In almost every power plant 20 or more years old there can be found obsolete equipment standing idle that could be put back into service with a little ingenuity.

Among the more interesting examples indicating what can be done in building new plants out of old equipment is that involving the power plant built near Freeport, Texas, to serve the Defense Plant Corporation's new magnesium recovery plant.[1]

Unfortunately, this isolated section of Texas is so far removed from the existing power supply that power cannot be made available for more than a small portion of this total load.

Even with A-1 priorities, however, at least 2 yr. would have been required for fabricating and installing a complete new generating station. In an effort to find a way out of this apparently hopeless situation some of the leading power engineers in the country were called in and after several weeks of persistent investigtaion, a plan was developed for assembling a combination of used and partly used equipment which it seems will solve the problem.

[1]This plant was described briefly in an editorial on p. 51, March issue.

The usefulness of the electric storage battery in the power plant as an emergency source of power is not always fully appreciated. They are often regarded as useful only in supplying emergency lighting service. There are many instances however, where they will carry vital power loads as well and their usefulness in such service will often far outweigh their uesfulness as a source of lighting power

Storage Battery EMERGENCY LIGHTING And POWER PLANTS

NOT LONG AGO, an electric power interruption occurred in a large industrial plant which lasted for 14 min. During this time, an emergency storage battery which, fortunately, had been installed at this plant, carried the process power load of about 720 amp. Short as this interruption was, the plant officials estimated that the storage battery had saved them more than $50,000 in damage to their equipment.

This is an excellent instance of the usefulness of an emergency storage battery installation. Storage batteries are often regarded as useful only in supplying emergency lighting service. This, without question, is one of their important functions and in most instances they are installed only for emergency lighting service, but there are many instances where their value will be much greater because of their ability to carry vital power loads as well. Although the total connected light and power load of a plant may be far in excess of the practical limits of the protective equipment, there are many vital processes and locations where a battery may enable the continuation of a vital process or may prevent serious damage to material or equipment or injury to employes.

A few examples of the type of protection that can be afforded by storage batteries may suggest others.

In engine and turbine rooms of all types of industrial and central station power plants to provide light for control panels, gages, and general illumination so that the operators can proceed with the work of restoring service and to enable them to make repairs if necessary.

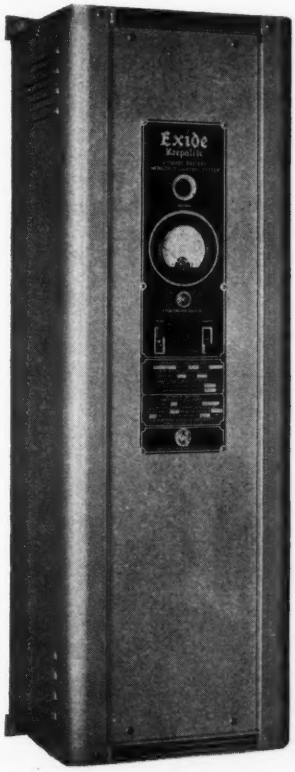


Fig. 1. A modern storage battery control unit. Units of this type incorporate complete automatic charging and control equipment for batteries of from 240 to 100,000 watt capacity. Photo, Courtesy, The Electric Storage Battery Co.

In boiler rooms to light control panels, valves, gages, regulators and other devices which must be operated in the event of power failure. Stairways which operators have to use to gain access to boiler equipment should also be lighted.

In transformer vaults to make repairs.

In general plant protection, to provide light for the safety of employes and so they may be able to leave the building without difficulty. Also to protect against sabotage in buildings and in the yards surrounding the plant. In some plants floodlighting of fences is provided by floodlights located in watchmen's towers at strategic points on the property. Provision should be made to operate such floodlights from the emergency battery in case of failure of the main power supply.

Emergency lighting is especially essential in windowless factories so many of which have been erected during the past 2 yr. in connection with the war program.

Power Protection

In a large number of industrial plants there are processes that require continuity of power to prevent loss of material or labor or

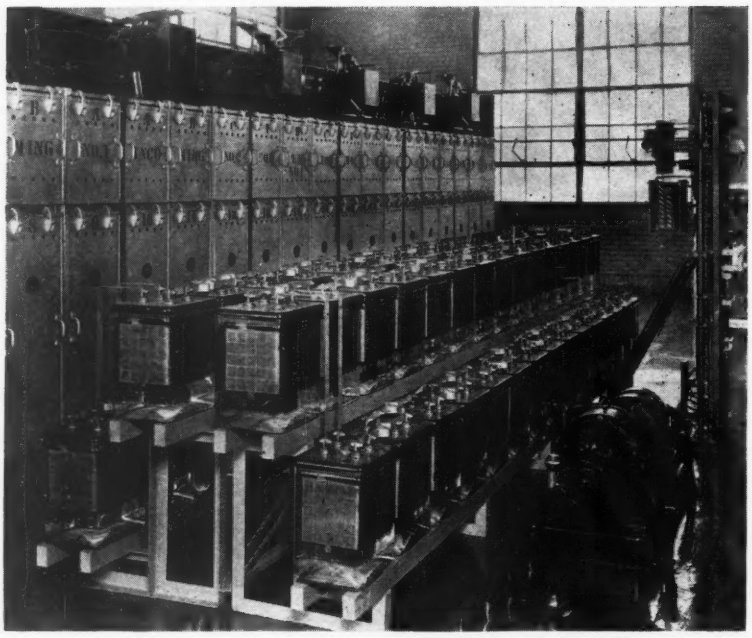


Fig. 2. A control bus battery installed in a water pumping station. As this photograph shows, the modern storage battery does not have to be installed in a separate battery room. Here it is installed in the same room with the switching equipment. Photo, Electric Storage Battery Co.

both which might amount to a considerable sum. Among plants of this type are the following: Ordnance, powder, chemical, steel, gear cutting works, glass manufacture, laboratories, etc. There are many plants using equipment which, if not kept in motion, will allow material to harden or set. In large bakeries using oven conveyors it is very essential that these be kept moving.

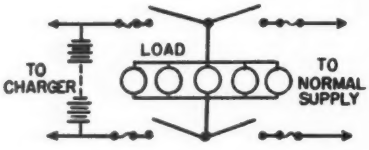


Fig. 3. A simple type of throw-over system

In gear cutting, especially in the case of very large gears of the type used in marine work, it is extremely important that the entire cutting operation be carried on from start to finish without interruption or inaccuracies will be introduced that may require scrapping of the entire gear. Since the cutting of a large gear may involve days of work the importance of having an emergency power supply available at split-second notice becomes readily apparent. In machine shops where magnetic chucks are used to hold work on lathes, failure of the power supply might result in the spoilage of very valuable work if provision is not made for instantly energizing such chucks from the emergency source. The amount of power needed by such devices is well within the capabilities of storage batteries. There are innumerable other cases where emergency batteries can be useful, but the foregoing examples will suffice to show the general nature of the applications. As in the case of the example cited at the beginning of this article the savings in material or work effected by a single emergency operation may be many times the cost of the battery.

Unlike the batteries of an earlier day, the modern storage battery is a very neat and reliable device. With the sealed glass jar construction universally used there is no spray to damage other electrical equipment and no separate room is required for their installation. For emergency power service where weight is not an important factor the lead-acid type cell is the most used; it is compact, needs little attention and is extremely reliable. Its discharge characteristics are such as to make them adaptable to almost any type of service, and when used with modern charging and regulating equipment they are essentially automatic in action.

A modern emergency installation consists of a number of cells to produce the required voltage, charging equipment and a control unit which will instantly supply current to vital circuits upon failure of the normal power supply. The operation of such a system is automatic. It requires no manual operation or attention except for the infrequent addition of water to the battery cells.

Installations can be designed for any reasonable voltage, but the usual installation consists of 60 cells for 115-120 v. service. Such a 60-cell battery is usually mounted on a wood rack designed to fit into any available space.

Various types of charging equipment are available, but for most installations the hot cathode mercury arc type of rectifier in combination with a copper oxide rectifier for trickle charging is found most convenient. Such charging equipment together with all necessary control equipment can be mounted in one compact cabinet such as the Exide unit

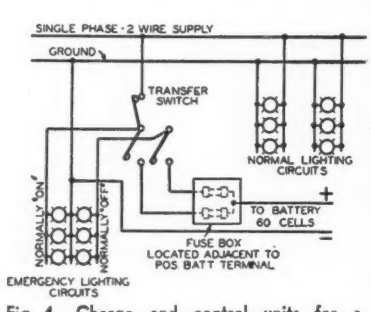


Fig. 4. Charge and control units for a single phase, 2-wire, a.c. system

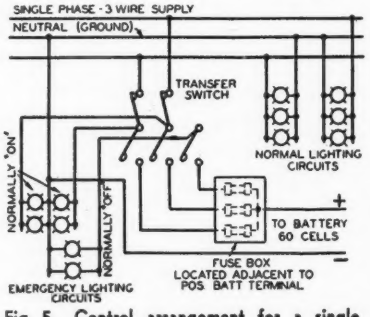


Fig. 5. Control arrangement for a single phase, 3-wire, a.c. system

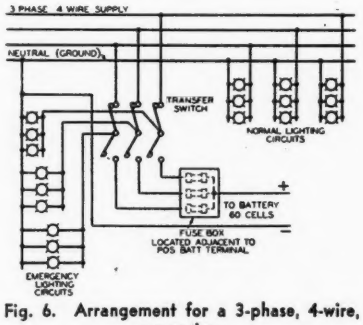


Fig. 6. Arrangement for a 3-phase, 4-wire, a.c. system

shown in Fig. 1. With a control unit of this type the operation of the battery is entirely automatic. As soon as the a.c. supply is restored after a power failure, the battery is placed on high rate charge, using the hot cathode mercury rectifier. This charge is continued until the battery is practically fully charged, when the high rate is cut off. The copper oxide rectifier then furnishes continually a small trickle or maintenance current just sufficient to maintain the battery in a fully charged state.

The automatic control of the battery recharge is accomplished by two relays, one of which is a temperature compensated voltage relay. This relay accurately controls the cut-off of the high rate charge, taking into consideration the variation in charging voltage for different battery temperatures.

An automatic transfer switch built into this control unit operates instantly upon failure of the normal power supply. This switch can be arranged for operation in connection with either single-phase, three-phase three-wire or three-phase four-wire alternating current circuits.

A voltmeter on the panel shows the battery voltage, the needle within the green zone on the scale indicating the proper trickle charge. In addition an audible signal is provided to indicate a break in the battery circuit.

Various arrangements of lighting circuits are possible in connection with these emergency battery installations. The simplest of course, is the plain throw-over system shown in Fig. 3. In this case the throw-over switch is equivalent to an ordinary double-pole double-throw switch. The load is connected to the middle points, the regular source of power to two of the outside contacts and the battery terminals to the two other contacts. When the regular source of power is on, the switch contacts are held in one position. If a power failure occurs, the battery or gravity or a spring actuates the switch to throw it to the other position which automatically connects the battery to the load without any interruption.

In many instances, however, it is not feasible to connect the battery to the normal lighting circuits and a special emergency circuit is provided. In such cases different switching arrangements are necessary, three of which are

"That looks suspicious—he's building a storage battery emergency plant"

shown in Figs. 4, 5 and 6. In these circuit diagrams it will be noted that in addition to the regular single or three-phase power circuits, there are other circuits designated "normally on" and "normally off". Here, the term "normally on" is used to designate a circuit which is normally supplied from the a.c. source and which is transferred to the battery during failure of the a.c. source as described above. The term "normally off" refers to a circuit which is energized only during failure of the a.c. source.

While lights and nearly all heating devices can operate either from alternating or direct current circuits, provided the voltage is right, it must be obvious that no alternating current motors or transformer equipment must remain connected to circuits which are liable to be thrown over to the battery during emergency.

Low Voltage Emergency Systems

The type of battery installation just described are meant for more or less general service over large areas. For small areas and for isolated services, small, low voltage battery units have been developed. In some cases such low voltage units incorporate automatic charging equipment which keep the batteries fully charged and ready for service at all times, but in other cases, the installation involves only the battery.

The ordinary type of storage battery, however, is not entirely satisfactory for the latter kind of service because it loses approximately 1 per cent of its capacity per day at normal temperatures due to internal discharge; therefore, the available capacity may be low when the power is most needed. This rate of internal discharge increases with an increase in temperature as it is more rapid during the summer months or in rooms having a high normal temperature. About 10 yr. ago, however, the Willard Storage Battery Co. developed a special type of battery with a very low rate of internal discharge. This rate is so low that it only amounts to 10 or 15 per cent loss over a year's time when the battery is standing idle. This battery has been used very extensively in many special installations and has been satisfactory in every respect. Although it was originally intended to be used at low rates of discharge yet higher current can be taken from it without harm.

Throughout the entire discharge of these low discharge batteries, extremely close voltage regulation is possible because, initially at normal temperatures, the voltage is approximately 2.12 and in determining capacities, the lowest cut-off voltage used is 1.8 v.

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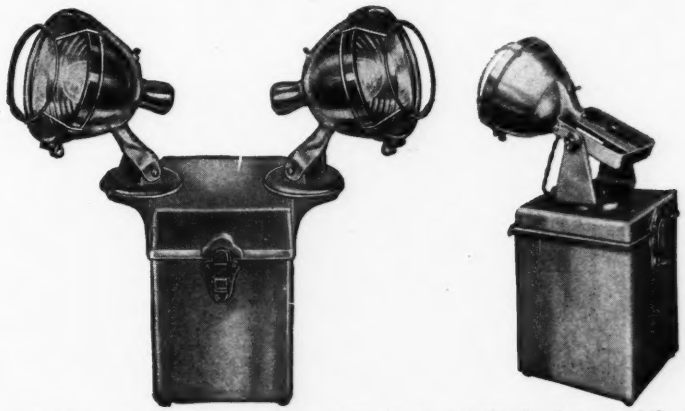


Figs. 7 and 8. Two types of portable emergency lamps made by the Carpenter Mfg. Co., using low-discharge batteries

As pointed out in this article very little information reaches us in regard to the damage done to electric utilities by aerial bombing but enough fragmentary information is still available to enable us to form certain estimates of the effectiveness of the aerial attacks and also to describe the general procedure employed in maintaining service. The experiences in Great Britain and other European countries described by Col. Bennion in this article will be found of interest

WARTIME DAMAGE TO POWER SUPPLY

BY H. S. BENNION
Vice President and Managing Director
Edison Electric Institute

ALTHOUGH published and generally available information in reliable technical form is scanty, it is still possible to estimate the situation of the principal public utility services in some of the belligerent countries after nearly two years of a kind of warfare that has borne with particular severity upon the civilian populations and upon civilian and industrial areas that have hitherto been regarded as beyond the zone of direct enemy action.

This article will discuss the experiences of electric power supply systems in particular, but with occasional reference to other utilities, mainly for the sake of the collateral evidence offered by their experiences.

The steady supply of electrical energy in adequate quantity is obviously important in connection with the production of war materials and in connection with the normal life of the civilian population. The more highly developed a region may be electrically, the more this will be true. An important measure of this supply is provided by the record of the amount of energy provided and of the peak or maximum demand upon the available generating facilities, following the outbreak of hostilities and thereafter during the course of the war.

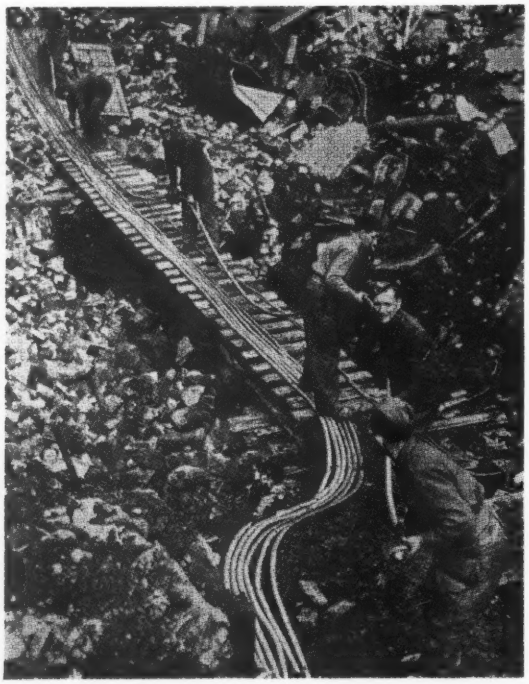


Fig. 1. Repairing London's bombed telephone system. Engineer emergency squads placing cables across large bomb-crater by means of a temporary bridge

Information on this subject is lacking from all of the continental countries of Europe. There have been indications from news stories in this country that German-controlled capacity and output has expanded tremendously. Known figures on past performance cast some doubt on the authenticity of these recent reports, although it is true that the Axis countries did achieve some large increases between 1936 and 1940.

The British, however, have furnished enough fragmentary information to warrant a highly generalized summary of the history of their electric supply during the war years.

For the last full year before the war, the production of electrical energy in Great Britain was in round numbers 25 billion kw-hr. The degree of electrification of the whole country as expressed in kw-hr. per capita, was in 1938 about 700 compared with about 1300 in the United States.

The matter of immediate concern, in the interest of war industries and war-time economy generally, is to determine how well the

electrical supply plant, as a whole, will bear up under the increased demands upon it. The measures of this performance are provided by output figures, which may indicate the extent to which the units of the production plant work for longer periods and at greater loads; and the record of the peak loads which indicate what extraordinary demands, if any, may be made upon the available machinery. Since the peak load is the more searching of these tests, it is possible to use information covering only a part of the war period, as the peak loads invariably occur during the winter months.

Output Slightly Increased

The general effect shown by statistics was that output was somewhat increased, but that peak loads were slightly diminished. This is what might be expected from an extension of working hours and multi-shift operation together with a general curtailment of civilian peace-time activities. The much publicized "blackout" as such, does not appear to have exerted a determining effect, but this may be because the available statistics do not permit an analysis of lighting and power loads.

Figures from a number of private companies, comparing the calendar years 1938 and 1939 are given below. The 1939 data comprises four months of war, but includes a direct comparison of pre-war and war periods of peak load:

Fig. 2. Extra permanent water pipes for London's supply. These pipes have been fitted through the streets as shown above the pavement. Numerous extra hose can be connected for supplying water in case of fire

	Calendar Year		
	1938	*1939*	*Change*
Output, kw-hr., millions	1654.9	1679.9	+1.5%
Max. demand, kw., thousands	497.7	477.6	—4.0%

Electrical utilities operated by public authorities in England and Wales render annual reports ending in March. Such statistics for 1939-40 therefore comprise five pre-war months and seven war months but as before contain a direct comparison of pre-war and war-time winter peak demands. Following is a compilation of seventy such public supply systems, widely distributed geographically, and comprising about one-tenth of the total output. Since these are the final distributing units to the average customers, the results may have special interest as indicators.

	Year Ending Mar. 31		
	1939	*1940*	*Change*
Output, kw-hr., millions	2400.0	2501.0	+4.2%
Max. demand, kw., thousands	902.8	873.8	—3.2%

While these statistical results indicate only a minor change in supply conditions, and along lines that might have been expected, it must be noted that in individual cases, generally speaking in smaller communities, much greater changes, sometimes of the order of 25 or 30 per cent up or down, may be noted. Although no explanation is available, these relatively large shifts which may have caused much concern to the people immediately involved, are no doubt due to that unexpected shifts of populations or of industries; they are however entirely local in character. In Germany, where scattering of industries to lessen their vulnerability has been extensively practiced, this local variation is probably more noticeable.

The results of military action in detail, so far as published and available material is concerned, has to be pieced together from information which is scarce and not highly informative at best, since the information is ordinarily for some other primary purpose and the applicable details occur only incidentally. However, it is possible to glean some factual information and even to classify it roughly into categories such as air bombing operations, artillery fire, and demolitions by retiring troops.

Air Bombing Only Temporarily Effective

Air bombing appears to be temporarily effective against utility distribution systems of all kinds, water, gas and electricity, so far as they occupy space on roads or streets, or under them. The effects in either case do not appear to be drastic or permanent, however, since either improvised or permanent repairs can be promptly made. The duration of outages due to damage lessens as experience instructs operating personnel in probable effects, proper preparation for these effects, and proper procedure in correcting the damage when it has occurred. Sectionalization of distribution circuits has been of great help, and procedure by this time has been organized and perfected.

The rupture of water mains is one of the most serious situations arising from bombing operations, since incipient fires from incendiary bombs may gain considerable headway for lack of means to fight them. The stress laid on the necessity for standing water supplies such as tanks, pools and other

Fig. 3 (Above). Royal Engineers at work in a large bomb crater in the London area

Fig. 4 (Right). Soldiers of the power circuits. Soldier repairmen high up attending to overhead wiring repairs outside a building damaged during a London air raid

forms of local water storage indicates the British estimate of this danger.

Although it cannot be stated with certainty because of lack of definite information, it appears that enemy bombing action has not succeeded in completely or permanently disabling electric generating stations. This despite the known fact that important generating stations have been objectives for bombing attacks and have probably been often hit and occasionally damaged. An article in the German press states that a Dutch generating station was "slightly damaged, but able to operate" although bombed and evidently hit, since the removal of a dud bomb from inside the works was necessary. That the effects of bombing upon modern fireproof generating stations is comparatively slight would seem to be confirmed by verbal reports of British experience and by the fact that if any large amount of generating apparatus had been disabled for any considerable time, the British output could hardly have been maintained at better than the prewar level.

Artillery Fire

The effects of large caliber artillery fire would seem, on the other hand, to be quite different and a good deal more severe. Another German article describing the restoration of utility services in Warsaw after its occupation in September 1939, contains considerable information on the effects of such fire. Although the Germans had bombed Warsaw heavily in connection with their general advance and during the seige, the damage to the power plant which they describe in this article is specifically attributed to artillery fire. Warsaw was subjected to artillery fire of all calibers for eight days; after the capitulation the following effects were observed.

Direct Hits Few

At least two turbogenerators had received direct hits and the remainder were damaged, although not severely. As a result of punctures by shells or fragments, none of the boilers were fit for service. Patches were welded on the boilers but the detailed methods of repairing the remaining apparatus were not specified. From the following time schedule for restoration some idea can be gained of the mechanical damage inflicted:

0 day—Station completely inoperative

5 days—Two units, aggregating 18,600 kw., in service

12 days—Third unit of 15,000 kw. in service

30 days—50,000 kw. of an original 107,600 kw. in service

Artillery fire disrupted the water supply. A rapid filter was completely wrecked and chlorinators seriously damaged. Failure of the electricity supply put the pumping plant out of service. The gas works were badly damaged, in most cases as the direct result of artillery fire. Thirty-inch pipes and valves were fractured, apparently upon impact of shells. Aside from efficiency and expedition in restoring these facilities to service, no unusual features were presented by this restoration work.

Another German article discusses the demolition methods employed by the Allied forces during their retirement from Holland, Belgium and northern France. It is related of a generating station in Belgium that had been wrecked by hand that many parts which could not readily be replaced from any available stock were merely broken. These parts included control instruments and insulators and insulating bushings. This simple and nontechnical method of demolition was evidently rather efficient. Restoration of service was temporarily delayed in other cases because of the removal of essential parts of apparatus by technical specialists among the retiring troops.

Nature vs. Bombs

From the above it would appear that the damage occasioned by bombing is actually not as severe as might be expected. Indeed, widespread storms, floods, hurricanes, ice storms and occasional fires have done much greater damage to utility plant and equipment in this country than seems likely from enemy action. The experience of the personnel of our electric utility companies in making repairs on the spot and under hazardous conditions would seem to fit them particularly well to combat any destructive effects of possible raids.

The first section of Venice No. 2 has just gone into service in the Saint Louis district. Located on the Mississippi and near the limitless fields of Illinois coal, this super power plant will soon add 240,000 kw. of highly dependable low cost power to the rapidly growing war industries now operating or building around this inland city. Dependability and high flexibility have been stressed for operation in parallel with large hydroelectric generating plants and distant, as well as nearby, steam plants. How these conditions and the high ash coal dictated features of design of the station is discussed below

VENICE NO. 2 — Power For War Production

By WILLIAM F. RYAN and EDWARD H. TENNEY

Asst. Chief Mech. Engineer
Stone & Webster Eng. Corp.
Boston, Massachusetts

Chief Engineer of Power Plants
Union Electric Co. of Missouri
St. Louis, Missouri

OF THE steam power plants now under construction, the largest of these is being built by the Union Electric Co. of Illinois on the east bank of the Mississippi at Venice, Ill., opposite St. Louis. Designed for an ultimate capacity of 400,000 kw., 240,000 kw. are now being installed in three sections of 80,000 kw. each. The first section was placed in operation in January, 1942; the second is scheduled for operation late this year; and the third as early as possible in 1943. The building for all three sections will be completed in 1942.

The site chosen for the plant on the Illinois shore opposite the near north end of St. Louis, is unusually favorable. The property, extending 5000 ft. along the Mississippi, had been developed in its northern end by a 40,000-kw. low-pressure station, Venice No. 1. For transmission and distribution this is a strategic location, being at the heart of the tri-state system extending through Missouri, Iowa, and Illinois.

It is half way between the Company's large Cahokia station, 5 mi. to the south, and Page Avenue station, 4 mi. to the west, which constitutes the principle major electrical interconnection between the Keokuk and Osage hydro plants and the St. Louis distribution system. The new plant is also conveniently close to heavy peacetime as well as war industries located to the north and east in adjacent Illinois territory.

A study of structural, yard, and equipment considerations indicated that there was no advantage in incorporating the new plant as a contiguous part of Venice No. 1, but the two structures are a few yards from one another and interconnected with steam, condensate and condenser circulating water lines.

Figure 1 is the architect's conception of the ultimate structure as it will appear from the river side, and Fig. 2 a recent construction view from the opposite side. It is apparent that the grouping of the plant's component parts, Fig. 3, is such that the boiler house is on the river front and the turbine room away from the river so that coal passes over the turbine room, and circulating water passes around the boiler house.

This arrangement was dictated by two considerations: (1) the power station building is, in effect, a structural part of the levee which protects this entire area from the flood waters of the Mississippi and it was desirable to avoid the deep excavation for the condenser room close to the levee crest; and (2) the fact that, while considerable power is sent directly across the river to St. Louis, the major part of the new capacity serves the transmission system in all directions, requiring a large outdoor substation which it was

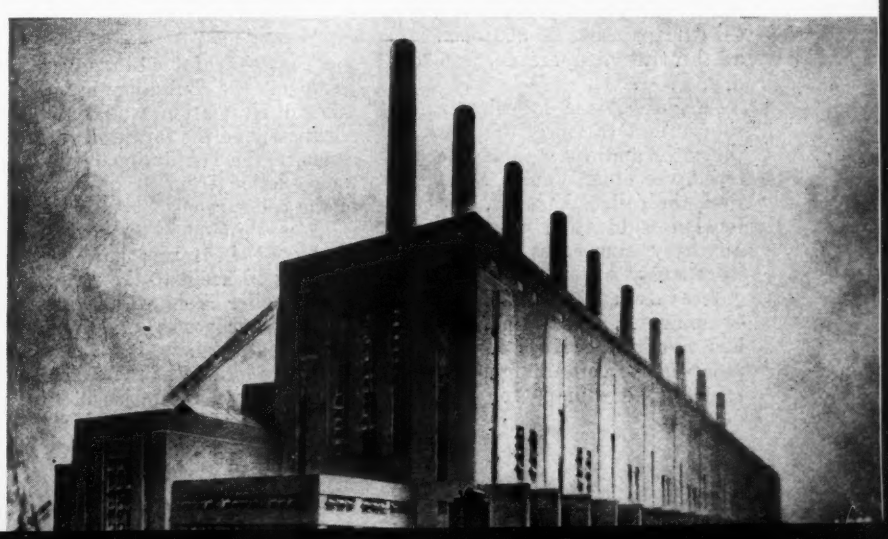


Fig. 1. Architect's sketch showing Venice No. 2 Station as it will appear completed to its ultimate 400,000 kw. capacity

Fig. 2. The station as it appeared just before Section 1 went into service. Section 2 is now under construction and Section 3 is scheduled for operation early in 1943

obviously advisable to locate on the land side of the plant, adjacent to the electrical and near the turbine bays.

Distribution across the river to St. Louis is provided by transformers on the levee adjacent to the station wall. A minor consideration in this arrangement is that it locates the unusually high boiler room far enough from the coal tracks to permit the use of a direct inclined belt from the Bradford breaker to the bunkers above the boiler.

General

Figure 5 shows a plan of the station at the turbine operating floor grade. The plant is laid out in three units of 80,000 kw. each. Each section has two boilers of 360,000 to 390,000 lb. per hr. capacity. For flexible operation in parallel with hydro plants, the first section has two turbine generators each of 40,000 kw. capacity, but the second and third sections each have a single 80,000 kw. unit. The plant is designed for a throttle pressure of 850 p.s.i. and a throttle temperature of 900 deg. F.

Figure 6 is a lot plan which shows the location of the plant on the site, and its relation to the levee, the older Venice No. 1 station, the railroad tracks, the high tension substation and various auxiliary structures such as the warehouse, water treating plant, gate house, coal and ash handling equipment, transformer repair house, and the river intake and pump house containing the circulating water pumps for the condensers.

The second section is structurally similar to the first, but contains a single 80,000-kw. turbine generator instead of two 40,000-kw. units. The third section will be substantially the same as the second with respect to the turbine room, but the boiler plant will be similar to the first section except that the air preheaters will be of the tubular instead of the regenerative type.

The plant is designed to burn Illinois coal with 4 per cent sulphur, 12.1 per cent moisture and a calorific value of 10,690 B.t.u. per lb. as received. On a dry basis a typical analysis is in per cent: volatile matter, 37.5; fixed carbon, 47.6; and ash, 14.9.

The electrical control room is located above the electrical bay. The sub-basement under the electrical bay and office building is essentially a part of the condenser room, with two 96 in. diam. circulating water lines, and one 108-in. discharge line running lengthwise in this space.

A pressure system of ventilation supplies cool clean air to all parts of the building in which natural circulation would not be adequate, and the forced draft fans assist in the ventilation by taking their suction from the upper part of the boiler room.

A machine shop approximately 80 by 60 ft. forms part of the building adjacent to the north end of the boiler room with a general toilet, locker rooms, and a lunchroom located above it. The plant offices are located at the end of the electrical bay, and adjacent to the turbine room. This space is simply but attractively finished, and the first floor is provided with a reception room which serves as the main entrance to the plant.

Coal is delivered from cars to a track hopper, conveyed to the Bradford breaker, and then on a long inclined conveyor to the bunkers. Every effort has been made to avoid a dust nuisance in handling coal. The car dumper is totally enclosed, and a suction system is provided for removing dust from this building, from the breaker house, and from each transfer point in the coal handling system. The bunkers are sealed at the trippers, and all dust collected is returned to the bunkers.

As part of a system largely supplied by hydro power, the plant will experience periods of standby operation at very low output, which combined with a low ash fusion temperature coal, precludes the use of slag tap furnaces. Also, experience has shown that dry bottom operation cannot be maintained with this coal except by very low heat release in the furnace.

These conditions had an important bearing on the physical size of the station because it limited the feasible output of each boiler to about 375,000 lb. per hr. and required furnaces of unusually large volume for that amount of steam as is shown in Fig. 3. The boiler specifications limited heat release in the furnace to 21,500 B.t.u. per cu. ft. per hr. below the mud drum, which is equivalent to a heat release of only 15,500 B.t.u. per cu. ft. for the gross volume of the entire furnace as normally computed by boiler manufacturers.

All boilers are of the bent tube type and each is provided with six horizontal burners and three pulverizers. Each boiler has an economizer and air preheating equipment, consisting of two regenerative type units for each boiler in the first section and single tubular heaters for the other four boilers. Details of the steam generating equipment and auxiliaries are given in the List of Equipment.

Ash Handling and Circulating Water Systems

Cottrell precipitators are provided for each boiler, as a contribution to the "clean air" program in St. Louis. Dust from the precipitators and from soot hoppers in the boiler settings is delivered to a silo north of the station

by a suction conveyor, while a sluicing system conveys the ash from the furnace bottoms to a sump. Provision is made for recovery of the fly ash in a dry state whenever market conditions make it worth while.

In 1925 a concrete caisson 63 ft. outside diameter and about 95 ft. in over-all height was constructed on the river bank at the inner harbor line to house pumps to supply the circulating water requirements of the Venice No. 1 steam station. These pumps were of the centrifugal type, three in number, designed to deliver 131,000 g.p.m. water under a maximum pumping head of 31 ft. Steel tubes extend from the pump house suction pipes out to the outer harbor line.

Estimated circulating water requirements of the new station (Venice No. 2) when equipped with the ultimate installation of two 40,000-kw. units and four 80,000-kw. units, amount to about 415,000 g.p.m., and the maximum requirements of the old station (Venice No. 1) are about 83,000 g.p.m., thus making a grand total of 498,000 g.p.m.

Adjustable Blade Propeller Type Circulating Pumps

To meet these requirements and provide spare pumping capacity it was decided to install four new pumps of 83,000 g.p.m., within the space limitations of the existing caisson and at a later date to construct a caisson of like size arranged to house four additional pumps of the same size. These pumps will supply both the old and new stations through two existing 8-ft. diam. steel pipe lines which pass under the levee.

In this phase of the project the major problem was to install a maximum pumping capacity within the limits of the existing river caisson and select pumping equipment best suited to operate under a very wide range of head and capacity. The pumping head may vary from a minimum of about 10 ft. to a maximum of about 46 ft., and any pump may be called upon to deliver from 10 to 110 per cent of its rated capacity. To meet these space limitations and wide range of operating head and capacity, the adjustable blade propeller type pump was found to have very definite advantages over a fixed blade pump.

It is unnecessary to throttle the discharge or vary the speed of the pump impellers and there is, therefore, a very material saving in the use of electric power whenever the head or capacity is less than the maximum rated capacity of the pumps. At the discharge end of these pumps a check valve is being installed. This valve is hydraulically operated and equipped with auxiliaries to automatically close the valve in case of power supply failure for any motor.

Feedwater System and Heat Balance

Figure 4 shows diagrammatically the fundamental arrangement of the feedwater system and heat balance for the first section of the plant. On account of the turbid condition of the river water, condensate exclusively is used in the generator air and oil coolers and the inter and aftercondensers of the steam jet vacuum pumps. This requires recirculation of condensate to the condenser at light loads, and, also recooling of the condensate during the summer months. The circulation, therefore, is from the condenser hotwell through the steam jet aftercondenser, thence through the cooler if necessary, thence through the generator air cooler and turbine oil coolers and into the fourth stage feedwater heater.

A float controlled valve throttles the condensate discharge, at a point beyond the coolers, to main-

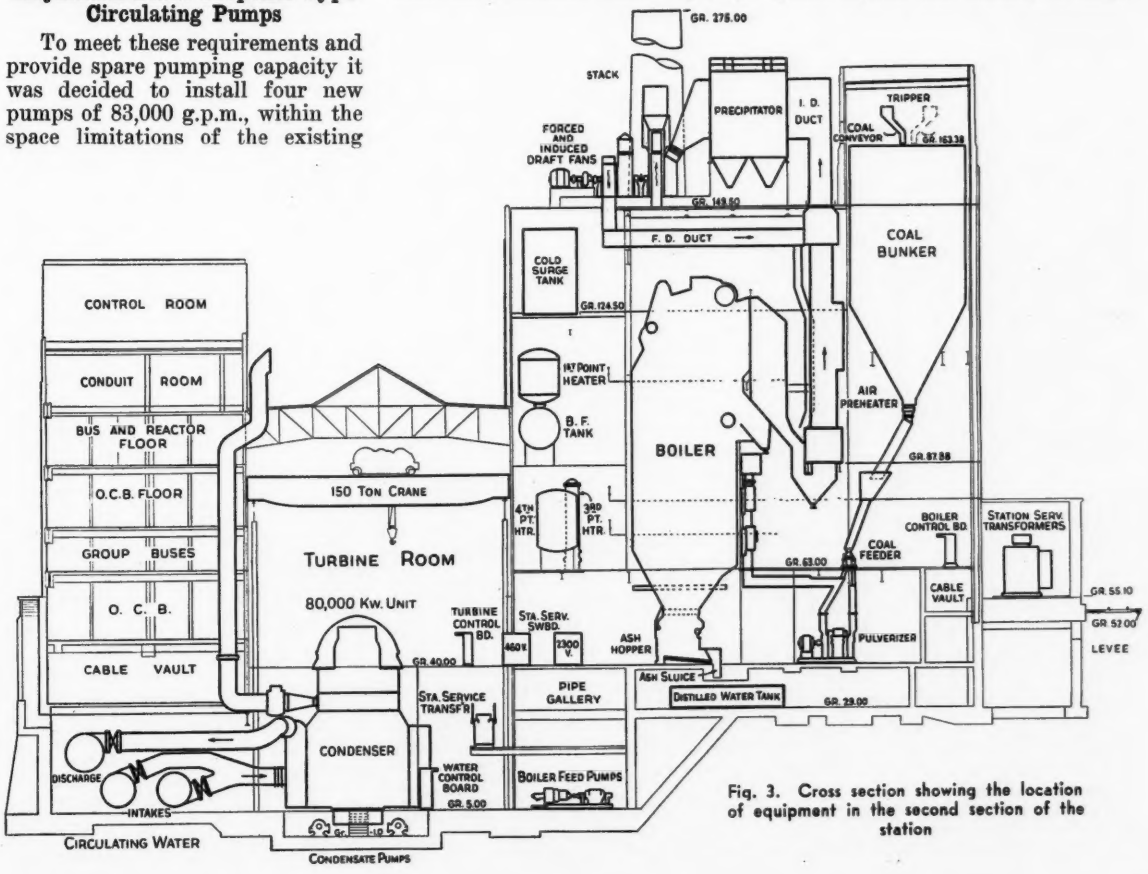


Fig. 3. Cross section showing the location of equipment in the second section of the station

tain an adequate positive head on the suction of the condensate pumps during periods of light load. A valve which is thermostatically controlled by the temperature rise across the steam jet vacuum pump condenser permits sufficient recirculation of condensate so that there is always sufficient flow for the cooling requirements of the steam jet condensers, generator air coolers and turbine oil coolers.

Condensate Storage

After passing through these condensers and coolers, the condensate is admitted by a float valve to the fourth stage heater. This is an open heater with a heated water storage of 3500 gal. capacity in which the float valve maintains a constant level. An elevated cold surge tank of 11,600 gal. floats on the inlet of this heater to take care of any difference between the condensate flow and heater requirements.

Condensate booster pumps deliver the heated water from the fourth stage heater through the third stage closed heater, a drip cooler, the evaporater condenser and the second stage closed heater to the first stage open heater. This heater is also provided with a storage tank of 7500 gal. capacity in which a constant level is maintained by the float controlled heater admission valve.

The first and fourth stage storage tanks have emergency overflows to the distilled water storage tanks which have a total capacity of 75,000 gal. From these tanks condensate is returned to either or both hot storage tanks or to the cold surge tank if the water level drops below a predetermined point. From the first stage storage tank the feedwater is pumped through the so-called "desuperheating heater" to the economizers of the steam generating units.

Each turbine unit has one evaporator, complete with preheater and condenser, taking steam from the second extraction point. The condenser is inserted in the condensate stream between the third and second point heaters so that the evaporator load has a negligible effect on the quantity of steam extracted at either point.

Each turbine unit has two condensate pumps, two condensate booster pumps, two heater drip pumps and two boiler feedpumps. All of the pumps except one boiler feedpump per unit are motor driven and all except the condensate booster pumps have constant speed drives. One of the latter is driven by a slip ring motor with a liquid rheostat for speed control while the others are driven by constant speed motors through hydraulic couplings. The pumps for the second and third sections have twice the capacity of those in the first, which is in proportion to the size of the main turbines and the quantities of water handled. The steam driven boiler feedpumps are purely for emergency use, automatically started by loss of pressure differential across the boiler feedwater regulators at the boilers.

Water Treating Plant

River water is used for evaporator feed and general plant service after clarification softening and filtering in a water treating plant. The river water is fed directly to the first of two vertical Spaulding precipitators which are arranged in series, providing two stage clarification before the water flows through the gravity filters. The precipitators are of the type that passes the water being clarified through the sludge bed, so as to reduce the use of chemicals to

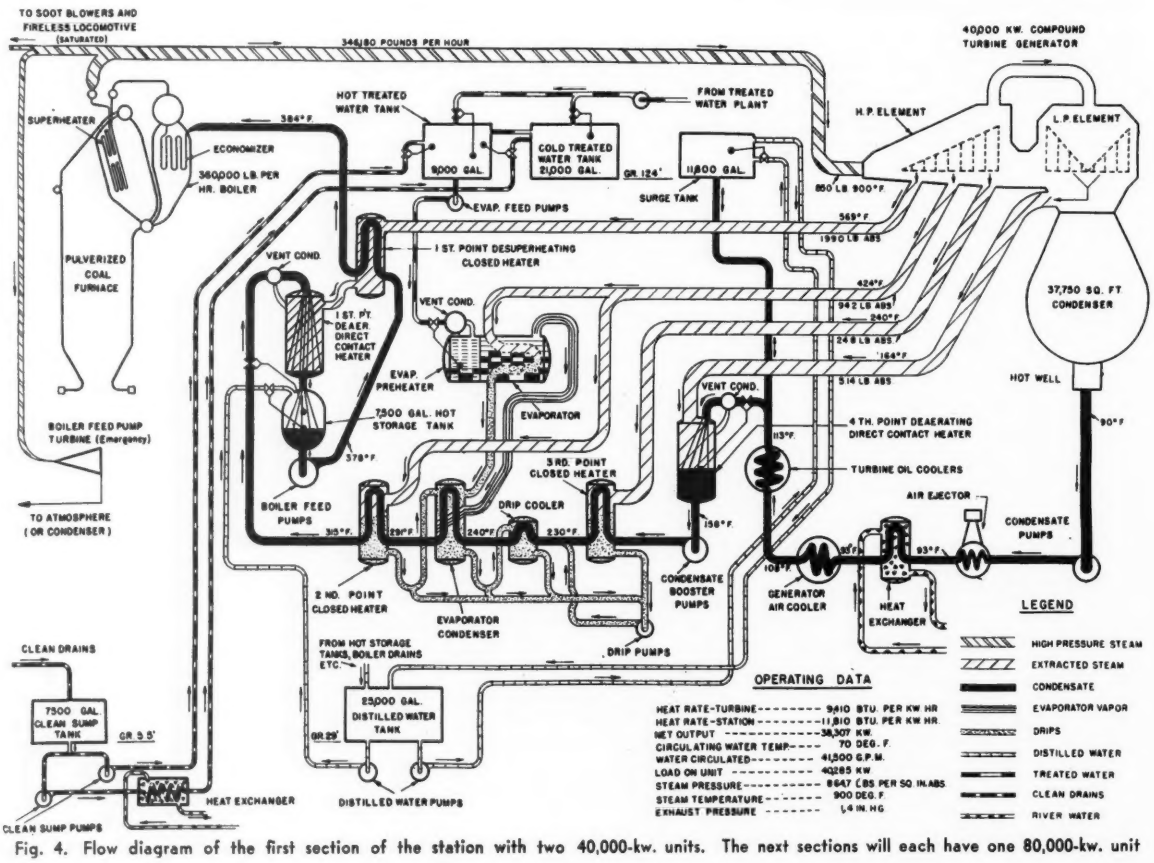


Fig. 4. Flow diagram of the first section of the station with two 40,000-kw. units. The next sections will each have one 80,000-kw. unit

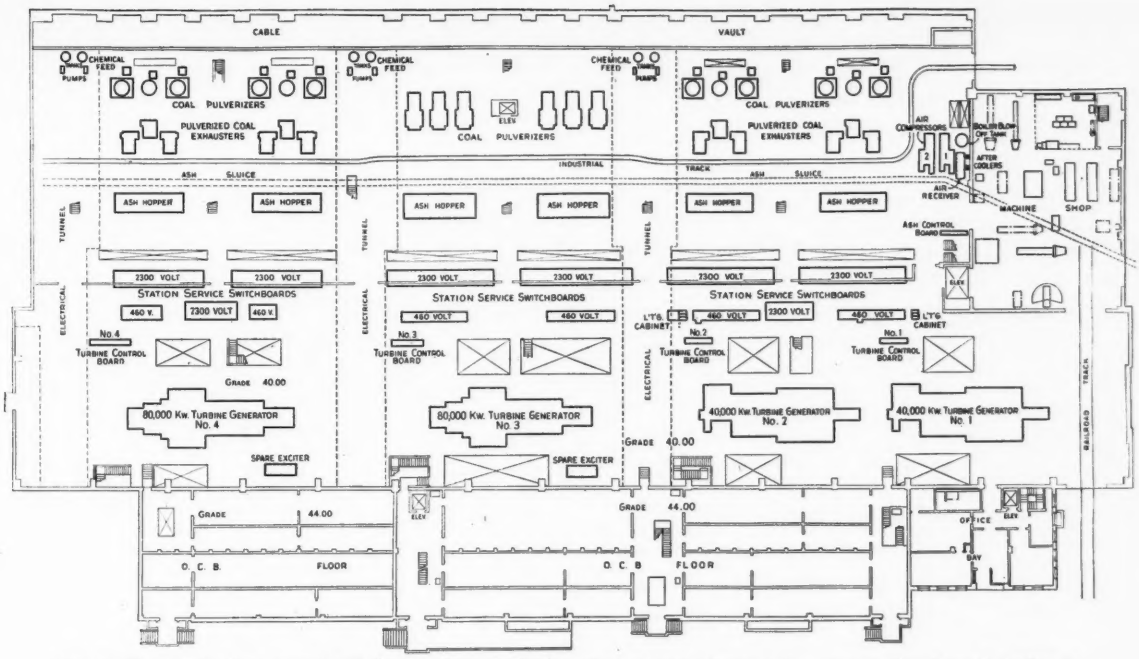


Fig. 5. Plan of the first, second and third sections at Grades 40.0 and 44.0. Figure 3 is a cross section through Section 2

a minimum. They are located out of doors; chemicals are stored in an adjoining building which also houses the chemical mixing and feeding equipment, filters, service and backwash pumps, and laboratory equipment.

Turbine Generators and Condensers

From the clear well beneath the filters, water is pumped to elevated storage tanks beneath the boiler room roof from which it flows by gravity to the several points of use. A clean sump collects jacket water and other uncontaminated returns and this water is pumped back to the elevated storage tanks for reuse. A heat exchanger is provided to cool this reclaimed water in the summer months.

The two 40,000-kw. units in the first section are tandem compound turbines, the low pressure element being double flow, driving air-cooled generators. The cooling system, including three motor driven fans and two coolers, is completely enclosed in the generator housing. The 80,000-kw. units in the second section are single cylinder impulse machines with hydrogen cooled generators.

To improve Tri-State system operation, including four other steam plants, and with distant hydro stations, the turbines are provided with special governors in addition to the standard type of governor. The special governors are a so-called "super-sensitive" speed responsive type with adjustable regulation, speed droop compensation, load and load limit indication and adjustment and are designed for a sensitivity of 1/100 of 1 per cent. The control will be arranged so that either governor can control the unit through a common regulating valve and hydraulic cylinder.

In addition, the change from one governor to the other, or from one adjustment to another, can be easily made while the units are in operation so as to observe their effects on system speed variations. This arrangement will provide considerable latitude in selecting the governor characteristics best suited to operating conditions on the system at any particular time. The governor system will be equipped so that the units may be synchronized from the switchboard room at any system speed from 5 above to 10 per cent below normal speed.

Instruments and Controls

Tubes in the 2-pass surface condensers are straight and not bowed. The tubes in each pass are pitched in the direction of flow to permit complete drainage on shutdown. Divided water boxes permit cleaning either half of any condenser while the turbine is in operation, and arrangements have been made for circulating heated air through the tubes to dry out slime and other adhesions, to facilitate cleaning.

A very complete system of instrumentation and control has been provided for all mechanical equipment. From boards located in the turbine room basement, the operators observe and control all details of the circulating water and feedwater systems. From the boiler room operating boards, adjacent to the coal feeders, the operators observe all details of the feedwater system and combustion apparatus, the latter being normally under automatic control. From the same boards, the operators can control combustion manually, and can take over the control of the feedwater supply system in an emergency.

Steam temperature is automatically regulated, but this can also be manually controlled from the boiler gage board. Remote controls at a central gage board are provided for fly ash removal from the precipitators and from the soot hoppers in the boiler settings.

The first section of the plant has been partly operated since January, and no serious difficulties in breaking in the equipment have been encountered. Boilers are showing good performance under the loads, carried to date, and the operating controls have been generally satisfactory. While it is too early to predict thermal performance it is apparent that the plant efficiency will be high. The fuel consumption of the plant is expected to very closely approximate that of the most efficient stations designed to date.

EQUIPMENT LIST—VENICE No. 2 STATION OF THE UNION ELEC. CO. OF MISSOURI AT VENICE, ILL.

Engineers and Constructors: Stone & Webster Engineering Corp., Boston, Mass.
Consulting Architects: Mauran, Russell, Crowell & Mullgardt, St. Louis, Mo.

STEAM GENERATING EQUIPMENT

	First Section	Second Section	Third Section
Boiler	Combustion Eng. Co.	Riley Stoker Corp.	Combustion Eng. Co.
Type	Bent tube	Bent tube	Bent tube
Heat. surf., sq. ft.	9,810	13,300	9,810
Water w., sq. ft.	7,495	7,470	7,495
St. drum diam., in.	54	60	54
Working pres., psi.	885	885	885
Cont. cap., lb./hr.	360,000	370,000	370,000
4-hr. cap., lb./hr.	390,000	400,000	400,000
Superheater	The Superheater Co.	Riley Stoker Corp.	The Superheater Co.
Heat. surf., sq. ft.	11,690	15,500	11,690
Final temp., deg. F.	915	915	915
Economizer	Combustion Eng. Co.	Riley Stoker Corp.	Combustion Eng. Co.
Heat. surf., sq. ft.	8,600	8,200	8,600
Air preheater	Air Preheater Corp.	Riley Stoker Corp.	Combustion Eng. Co.
Type	Regenerative	Tubular	Tubular
Number	2	1	1
Heat. surf., sq. ft.	30,600	76,000	74,800
Pulverizers	Combustion Eng. Co.	Riley Stoker Corp.	Combustion Eng. Co.
Number	2—Main 1—Light load	3	2—Main 1—Light load
Type	Raymond Bowl	Duplex Atrita	Raymond Bowl
Capacity, lb/hr.	26,500 8,000		26,500 8,000
Fuel burners	Combustion Eng. Co.	Riley Stoker Corp	Combustion Eng. Co.
Type	Type R	Classifying horiz. forced draft	Type R
Number	4—Main 2—Light load	6	4—Main 2—Light load

ELECTRIC GENERATING EQUIPMENT

	First Section	Second Section	Third Section
Turbine generators	Allis-Chalmers Mfg. Co.	General Elec. Co.	General Elec. Co.
Number	2	1	1
Cap., each, kw.	40,000	80,000	80,000
kv-a.	50,000	100,000	100,000
Power factor	0.8	0.8	0.8
Cooling system	Air	Hydrogen	Hydrogen
Speed, r.p.m.	3,600	1,800	1,800
Throt. pres., psi.	850	850	850
Throt. temp., deg. F.	900	900	900
Nor. vac., in. Hg.	1.5	1.5	1.5
Extraction points	4	4	4
Surface condensers	Worthington Pump & Machinery Corp.	C. H. Wheeler Mfg. Co.	C. H. Wheeler Mfg. Co.
Number	2	1	1
Surface, sq. ft.	37,750	75,000	75,000
Shell	Welded steel	Welded steel	Welded steel
Tubes			
Number	6,000	12,000	12,000
Diameter, in O.D.	1	1	1
Gage, B.w.g.	18	18	18
Mixture	Admiralty	Admiralty	Admiralty
Condensate pumps			
Number	4	2	2
Capacity, g.p.m.	720	1,440	1,440
Speed, r.p.m.	860	860	860

CIRCULATING WATER SUPPLY

	First and Second Sections
Pumps	S. Morgan Smith Co.
Type	Adjustable blade propeller
Number	4
Capacity g.p.m.	83,000
Total dynamic head, ft.	45
Speed, r.p.m.	514
Drive	1,400 hp. constant speed motor
Intake screens	Link Belt Co.
Number	4
Width, ft.	10
Priming systems	Nash Engineering Co.
Circ. water lines	Chicago Bridge & Iron Co. & Wailes Dove-Hermiston Corp.
Circ. water gate valves	The Chapman Valve Mfg. Co.

COAL AND ASH HANDLING EQUIPMENT

Car dumper—The Wellman Eng. Co.
Bradford breaker—Heyl & Patterson, Inc.
Conveying system—Robins Conveying Belt Co. Two main belts, 30 in. wide; speed, 370 f.p.m ; capacity, each belt, 250 t. per hr.
Coal sampler—Thorsten Sampler Co.
Ash hoppers—The Allen-Sherman-Hoff Co.
Ash sluicing system—The Allen-Sherman-Hoff Co.
Fly ash precipitators—Research Corp. Electrostatic type, two units per boiler.
Fly ash collecting system—United Conveyor Corp.
Fly ash storage silo—The Allen-Sherman-Hoff Co.

VALVES

First and Second Sections

Boiler nonreturn—Schutte & Koerting Co., both sections.
High pressure steam—Walworth Co., both sections.
H.P. water-gate—The Chapman Valve Mfg. Co., both sections.
H.P. water-checks—Walworth Co., first section, The William Powell Co., (Braman, Dow & Co., agents), second section.
Gate, globe and check—400, 300 and 150 lb.—The Chapman Valve Mfg. Co., first section. Reading-Pratt & Cady Co., Inc., second section.
Globe and check—Small H.P.—Manning, Maxwell & Moore, Inc., both sections.
Globe and check—Small 400 lb.—The Edward Valve and Mfg. Co., Inc., both sections.
Gate, globe and check, 125 lb. gate—The Ohio Injector Co., both sections.
Extraction steam-reverse flow—Atwood & Morrill Co., first section. Ruggles-Klingemann Mfg. Co., second section.
Atmospheric relief—Atwood & Morrill Co., first section. Davis Regulator Co., second section.
Continuous blowdown-regulating — The Strong, Carlisle & Hammond Co., both sections.
Relief—Crosby Steam Gage & Valve Co., both sections.
Blowoff—The Edward Valve & Mfg. Co. and Yarnall-Waring Co., first section. Yarnall-Waring Co., second section.

INSTRUMENTS

Bailey Meter Co.—Differential pressure indicators, boiler meter, flow meters, boiler water level recorders, vacuum recorders.
The Ellison Draft Gage Co.—Draft gages.
Cochrane Corp.—Water level recorders and indicators.
Northern Equipment Co.—Boiler feedwater regulating equipment.
Crosby Steam Gage & Valve Co.—Indicating pressure gages.
The Foxboro Co.—Oil tank level indicators, temperature indicators, pulverizer air temperature controllers, boiler feedpump disch. pres. recorders.
Leeds & Northrup Co.—8 pt. air and gas temp. recorders, CO_2 recorders, steam temperature recorders, pH recorders, conductivity recorders.

The Meriam Co.—High pressure test manometers.
C. J. Tagliabue Mfg. Co.—Temp. recorders, feedwater system.
Taylor Instrument Co.—Industrial thermometers.
Barometer and vacuum gages.
Weston Electrical Instrument Co.—Tachometers—Forced and Ind. Draft Fans.

MISCELLANEOUS EQUIPMENT

Piping—Midwest Piping & Supply Co., Inc.
Remote valve control — Philadelphia Gear Works, Inc. Limitorque control on 12 to 16 in. gate valves on 900 and 300 lb. steam and 400 lb. water lines.
Pipe covering—The Ruberoid Co., installed by the St. Louis Insulation Co.
Combustion control—Bailey Meter Co.
Flues and ducts—Missouri Boiler & Sheet Iron Wks.
Coal hoppers and tanks—John Nooter Boiler Wks. Co.
Water purification system—The Permutit Co.
Feedwater regulators—Northern Equipment Co.
Chemical feed equipment—Hagan Corp.
Level controllers—The Swartwout Co. and Mason-Neilan Regulator Co.
Desuperheating equipment—The Swartwout Co.
Screen wash pumps—Worthington Pump & Mach. Corp., first section, and Allis-Chalmers Mfg. Co. (Layne & Bowler) second section.
Service water pumps—Union Steam Pump Sales Co.
Evaporator feed pumps—Worthington Pump & Machinery Corp.
Fire pumps—The DeLaval Steam Turbine Co.
Condensate coolers — Foster Wheeler Corp.
H.P. distilled water pumps—Worthington Pump & Machinery Corp., first section and Ingersoll-Rand Co., second section.
L.P. distilled water pumps—Worthington Pump & Machinery Corp., first section, and Allis-Chalmers Mfg. Co., second section.
Lubricating oil pumps—Quimby Pump Co., Inc.
Fuel oil pumps—Schutte & Koerting Co.
Transformer oil pumps—Schutte & Koerting Co.
Dust collecting system—Dracco Corp.
Vacuum cleaning system—U. S. Hoffman Machinery Corp.
Heating—American Radiator Co. and American Blower Corp.
Plumbing — Galloway Von Gruenigen Plumbing & Heating Co.
Ventilating fans—Buffalo Forge Co.
Sluice gates—The Chapman Valve Mfg. Co.
Locomotive crane—Browning Crane & Shovel Co.
Fireless locomotive—Heisler Locomotive Wks.
Air compressors—Worthington Pump & Mach. Corp.
Soot blowers—Diamond Power Specialty Co., all three sections.
B. water columns—Reliance Gauge Column Co., all three sections.
Turb. room crane—Cleveland Crane & Eng. Co.

FEED WATER SYSTEM

	First Section	Second Section
Condensate booster pumps	Union St. Pump Sales Co.	Allis-Chalmers Mfg. Co.
Number	4	2
Capacity, g.p.m.	840	1,680
Head, ft.	938	950
Speed	1,750	1,750
Drive	1 slip ring motor, 3 constant speed motors with Am. B. Co. hyd. coup.	Constant speed motor with American Blower Co. hydraulic coupling
Boiler feedpumps	Worthington Pump & Machinery Corp.	Ingersoll-Rand Co.
Number	5	3
Capacity, g.p.m.	1,000	2,000
Head, ft.	2,435	2,435
Drive	3 constant speed motors 2 turbines	2 constant speed motors 1 turbine
Open heaters	Foster Wheeler Corp.	Foster Wheeler Corp.
Number	4	2
Closed heaters & Drain Coolers	Westinghouse Electric & Mfg. Co.	Alco Products Division of American Loco. Co.
Number	8	4
Evaporators & condensers	Foster Wheeler Corp.	Foster Wheeler Corp.
Number	2	1
Capacity each, lb./hr.	23,100	23,100

DRAFT SYSTEM

	First and Second Sections
Stacks	Wiederholt Construction Co.
Type	Reinforced tile
Diameter at top	9'-6"
Number per boiler	1
Height above ground, ft.	236
Draft fans	Green Fuel Economizer Co., Inc.
Number per boiler	2
Type	Duplex
Capacity, c.f.m., forced draft	62,500
c.f.m., induced draft	12,500
Pressure, in. of water, forced draft	12
in. of water, forced draft	16
Drive	Constant speed motor with American Blower Corp. hyd. coup.
Motor speed, r.p.m.	900

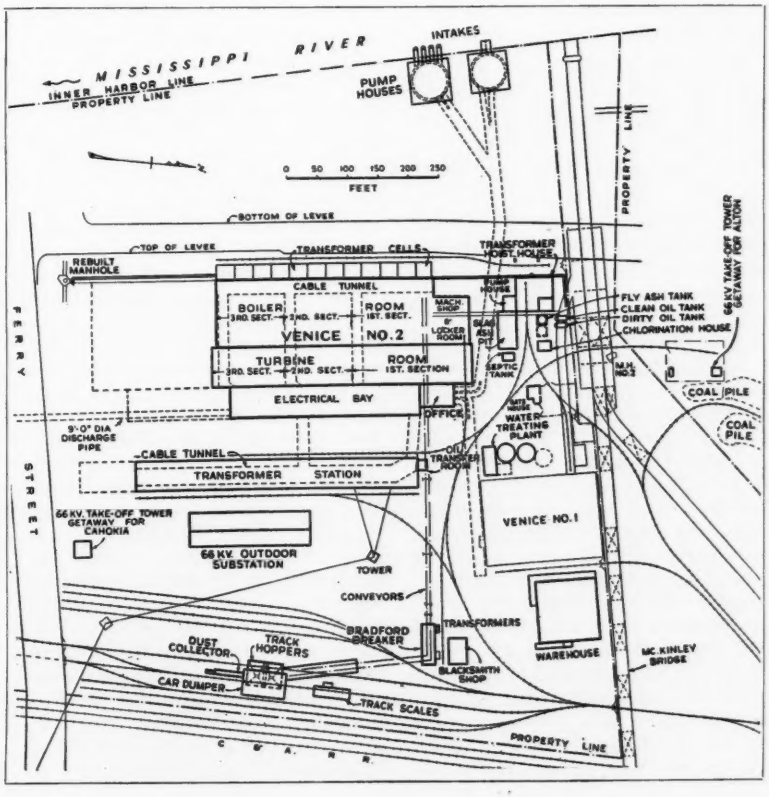


Fig. 6. Location plan showing Venice No. 1 and Venice No. 2 stations in relation to other structures just south of the McKinley Bridge. The 9 ft. diam. circulating water pipe discharges to the river about 150 ft. south of Ferry Street

POWER and The War Effort—

THE FIFTH MIDWEST POWER CONFERENCE since its reorganization in 1939 was held, as in previous years, at the Palmer House in Chicago, April 9 and 10. Power, being the enormously vital commodity it is in war production, it was inevitable that the conference would be well attended this year, and it was. Highlighted by an important address by the chairman of the Federal Power Commission, the program was sufficiently diversified to sustain a wide variety of interests. It is in this respect that this conference fulfills a distinct need; it provides an opportunity for those highly specialized in one branch of the power industry to learn something about developments in other, closely related, branches of the field.

The conference was opened with an address of welcome by H. T. Heald, President of Illinois Institute of Technology and after a brief response to this welcome by Dean Potter of Purdue University, Leland Olds, Chairman of the Federal Power Commission presented his address entitled "Power and the War Effort".

Power and the War Effort

In many ways this address by Mr. Olds was perhaps the most important, certainly the most spectacular, address of the two-day meeting. It not only brought home to everybody present the importance of power in the war effort but it opened up once more the long standing controversy between the "Commission" and the Electric Utility Industry, over possible power shortages. In a vigorous plea for long range power planning he implied that the electric utility industry had pursued a *laissez-faire* policy in this respect in the past and that, as a consequence, we did not have the ample power reserves that we might have had or that the electric utility industry claimed we had. Referring to the recent annual report of President Kellogg of the Edison Electric Institute in which he indicated "a generous paper surplus of generating capacity to carry the war load," Mr. Olds said that this statement was extremely misleading. If such figures as Mr. Kellogg offered should prevail as a basis for planning power supply to meet the country's war needs, Mr. Olds said it would spell disaster.

Power planning, said the Chairman of the Commission, is the reconciliation of all other war planning because power is used by all the war industries and all the soldiers and all the people. If the tragic story of "too little and too late" is repeated in the power field, the net result would be a delay in the production of vital war equipment with an attendant loss of life and—quite possibly—of the war itself.

"Since 1935," continued Mr. Olds, "the Federal Power Commission has been reviewing the power situation throughout the country in terms of the requirements of war and planning the steps necessary to assure adequate power supply for a supreme war effort. Throughout its work, the Commission has been constantly attacked on the score that it was exaggerating the power requirements of war. Its estimates have been interpreted by some as designed to serve the ulterior purpose of establishing a basis for further Federal Power Development."

Since an abstract of Mr. Olds' paper is presented in other pages of this issue it is unnecessary here to discuss the paper in greater detail, but its impact upon the Conference was considerable and it attracted nation-wide attention.

An entirely different aspect of the national power situation though a very vital one was considered in a paper following that of Mr. Olds, presented by V. G. Leach, Chief Combustion Engineer of the Peabody Coal Co. Mr. Leach discussed the "Prevention of Steam Losses and Fuel Waste." According to estimates Mr. Leach said 35,000,000 tons of fuel or more are going to be wasted in this country in 1942 and, as he pointed out, the unfortunate aspect of this staggering waste is that it could easily be prevented. This waste is the result of many things, inefficient boiler installations, overloaded plants, obsolete equipment, poor management, inadequate inspection, etc. As the speaker pointed out, if anything needs to be encouraged, it is frequent inspection by competent combustion engineers. A boiler room may be in excellent condition, and yet, some "little thing" can keep it from performing the way it should.

Referring to a recent report of the Chicago Department of Smoke Inspection and Abatement, Mr. Leach said, as a result of inspecting 26,785 boilers in the first nine months of 1941, 9248 repair notices were sent to building owners. Since January, 1940, the Department has sent out over 25,000 repair notices. In Atlanta, Georgia, the Smoke Abatement Bureau, he said, is making recommendations on over 90 per cent of the plants inspected. In this area over 50 per cent of the installations are in need of serious repair. Koppers Coke, Mr. Leach reported, inspected 12,116 heating plants last year; their service men sealed leaks in 11,545; installed 896 dampers and air checks. They reported only 571 furnaces or 5 per cent in "satisfactory" condition. In large industrial plants conditions are immeasurably better,

As reflected by the Proceedings and Technical Papers of the Midwest Power Conference held at the Palmer House in Chicago, April 9 and 10. Highlighted by an important address by Leland Olds, Chairman of the Federal Power Commission, the two-day meeting was well attended and attracted nation-wide attention

but even here from 10 to 30 per cent of the plants—depending on their size and load—need attention, alterations or repairs.

Maximum Output from Plants

Closely related to the subject discussed by Mr. Leach, was the paper presented by E. G. Bailey, Vice President of the Babcock and Wilcox Co. Mr. Bailey's subject was "Maximum Output from Existing Boiler Plants." As steel and other metals which ordinarily could be used in building power equipment are now more urgently needed for ships and guns and ammunition, Mr. Bailey pointed out that the stations now operating will have to supply nearly all of the power needed to see us through the war. As a result, power plants formerly operating with comfortable capacity factors will be stepped up close to or beyond, the 100 per cent mark. This makes intelligent inspection, repair and operation more vital than ever. The purpose of Mr. Bailey's paper, therefore, was to indicate the various means available today to keep plants running in top notch condition. The things he discussed were not new—they are known to all good power plant engineers—but it is very important that they be kept in mind at all times under present conditions. A more detailed abstract of Mr. Bailey's paper is presented in the other pages of this issue.

Another address of considerable interest was that by F. H. Rosencrants, Vice President of Combustion Engineering Co., describing briefly the C-E Controlled Forced Circulation boiler at Somerset Station of the Montaup Electric Co. This unit was completely described in the January number of POWER PLANT ENGINEERING so the details of Mr. Rosencrants' address will not be given here but this extremely unusual boiler deserves the serious attention of all American power engineers and it was fitting that it occupied a place in the program of this Conference. When it is considered that the circulating pumps associated with this boiler handle several times as much water as the total steam production rate of the unit, regardless of load, it will be quite apparent that the circulation through this boiler is of an extremely "positive" nature. It is in this positive circulation that this boiler differs so markedly from the existing American boilers.

The Midwest Power Conference was reorganized in 1938 as a co-operative institution with university and technical society associations. The major responsibility and sponsorship has been centered in Illinois Institute of Technology which operates the conference with the co-operation of the state universities and the local and national societies. The purpose of the conference has been established as that offering an opportunity for all persons interested in power production, transmission or consumption to meet together annually for the study of mutual problems free from the restrictions of required membership in technical or social organizations. The academic sponsorship permits the freest possible discussion ranging from the technical through the economic and into the social aspects of power.

Lightning and Lightning Protection

The Conference program included two "electrical" sessions, one devoted to the general subject of lightning and lightning protection, and the other to "power transmission". The two papers presented at the "lightning" session were designed largely to show those not familiar with recent developments, what has been accomplished in recent years in the study of lightning phenomena and in protecting our transmission lines against its destructive effects. Charles F. Wagner, Manager of the Central Station Engineering at Westinghouse first described recent field experience with natural lightning and this was followed by a paper on lightning proof line design by A. C. Monteith, Manager of Industry Engineering of Westinghouse. Mr. Wagner's paper was concerned with the details of charge formation in clouds, the mechanism of the discharge and the methods and instruments available for measuring the properties of lightning.

As a consequence of the accumulated data from lightning studies all over the world, Mr. Monteith showed that it was possible, today, to build "lightning proof" transmission lines and that a number of such lines were actually in existence.

In the discussion of these papers, Professor Newman of the University of Minnesota recounted an interesting case in which an airplane had been struck by lightning while flying through the clouds. The plane was not damaged except that part of the radio equipment was put out of commission, but a careful investigation and analysis of pitting on the metal propellor blades made it possible to determine that the stroke had been in its formative stage. The discharge had hit the propellor and since this was rotating at high speed the pitting produced by the individual discharges in the multiple stroke were displaced from each other by the distance the propellor blade moved between the "stepped leaders". Knowing the speed of the propellor and the diameter of the circle on which the pitting oc-

curred it was possible to calculate the time interval between the stepped leaders.

Electrical Transmission

The second electrical session was devoted to a discussion of most recent practice in electrical transmission with regard to (1) Ground fault neutralizers and protector tubes, (2) High-speed relaying, and (3) High-speed reclosing circuit breakers. J. R. North, Assistant Electrical Engineer, Commonwealth and Southern Corp., briefly described recent practice in the use of the Peterson Coil and the characteristics and use of the protector tube. These devices, as the author pointed out, were designed to provide a low-impedance path to the ground for ground fault currents. High-speed relaying, on the other hand, presented by W. A. Lewis, Director of the School of Electrical Engineering, Cornell University, sought to isolate the portion of the line on which the fault occurred as quickly as possible. The third phase of the subject, presented by J. E. Hobson, Director of the Department of Electrical Engineering, Illinois Institute of Technology, was closely related to the relay problem in that the action of the high-speed reclosing breaker is, in part, controlled by the relays on the system. The three presentations gave a very good idea of what is involved in the modern transmission protective system.

A session on Industrial Power Plants included a paper on Power in the Flour Milling Industry by A. R. Ulstrom, of the Cereal Engineering and Construction Co., one on Feedwater Treatment in Small Plants by Everett Partridge, Director of Research of Hall Laboratories, and finally a paper on Power Recovery in the Testing of Airplane Engines at the Buick Plant of General Motors at Melrose Park, Ill. This paper was presented by C. A. Chayne, Chief Engineer of the Buick Motor Division. This system of recovery is one of the most elaborate ever used and the details are described in the abstract of Mr. Chayne's paper in this issue.

Radial Diesel, 600 Hp. Weighs 3000 Lb.

Without question one of the most interesting addresses of the Conference was that delivered by E. T. Vincent, Professor of Mechanical Engineering at the University of Michigan, on the subject of Radial Diesels. In this paper he described the development and construction of a 600 hp. radial Diesel engine for stationary use. This unit weighs only 3000 lb. and is 38 in. long. It is mounted directly on the engine room floor with no special foundation and is so well balanced that in tests made, a pencil stood on end and a nickel stood on edge on the rounded surface of the frame for a period of 24 hr. while the engine operated at full speed. It is mounted on steel springs and equipped as it is with flexible fuel connections it is entirely isolated from the rest of the building in which it is installed.

The relative merits of Diesel and steam locomotives were presented at this same session by Robert Aldag of the C. B. & Q. R. R. Among many other things of interest, Mr. Aldag pointed out that a Diesel is available to produce 77 per cent more train miles in passenger service on the Burlington than the best steam locomotive record.

At the "Boilers and Stokers" session three papers were presented, one by R. N. Bucks, Superintendent of Power Plants for the Studebaker Corp., on results obtained by spreader stokers, one on "Steam Boiler Circulation" by A. A. Markson, and a third on "Coal Research and the War Effort" by A. W. Thorson, of the Carnegie Institute. The latter was of particular interest in that it included statistics on the coal resources of the various countries of the world. While Japan's fuel situation is not definitely known, Mr. Thorson said the latest coal production figures show only 45 million tons in Japan proper. Manchuria produces some 15 million tons and, now, they get some coal from North China. Compared to our own great coal resources these figures are small, indeed, but Mr. Thorson insisted that that was no reason for self complacency. He urged everybody to stock fuel to the limit of their facilities and, of course, to utilize all fuel as efficiently as possible.

At the one "Hydro Power" session, E. W. Lane, Professor of Hydraulic Engineering at the State University of Iowa, presented a paper on the Silting of Water Power Reservoirs. This, obviously, is a very important question, particularly now when so many of our great Federal hydro projects are going into operation. While much is known about the formation of sediment deposits in reservoirs, the problem in general is one which the engineer has not yet been able to solve. Said Mr. Lane in closing his address, "Fame awaits the engineer who can accomplish it."

The high social event of the Conference was the "All Engineers" Dinner on Thursday evening where Col. Willard Chevalier, Vice-President and Director of the McGraw-Hill Co., delivered a stirring address criticizing our attitude to the war. The American people, he pointed out, are entirely too self-complacent about the war and think that they can win the war merely by buying bonds, or inventing slogans or making up songs or fortifying themselves against the shortages in "gadgets". There is only one way to win this war, said the Colonel, and that is by fighting; and by fighting he meant fighting the enemy on all fronts. Fighting, he continued, had nothing to do with resources. The Japs, he said, had few resources, yet they know how to fight. The Germans were numbered among the "have nots" and they know how to fight. The Russians, on the other hand, have great resources, but they also know how to fight. A fine speaker, apparently very sincere in what he said, Col. Chevalier's address made a great impression upon the audience.

The two luncheon meetings, one held jointly with the A.S.M.E. and the other jointly with the A.I.E.E., were pleasant interludes between the formal sessions and both were marked by interesting addresses. At the luncheon with the A.S.M.E., Otto K. Jelinek, Chief of Techniques, Chicago Metropolitan Area, described the problems connected with blackouts and bombings and recounted the work which had been done in the Chicago area on this phase of civilian defense.

At the A.I.E.E. luncheon, H. W. Eales, Chief Electrical Engineer of The Public Utility Engineering and Service Corp., gave an extremely interesting talk on "Preventing and Extinguishing Electrical Oil Fires". Mr. Eales' address was illustrated with both motion pictures and slides and these demonstrated the extreme effectiveness of the use of CO_2 and also of high pressure water sprays in fighting oil fires.

Midwest Power Conference

Power and The War Effort

By LELAND OLDS
Chairman, Federal Power Commission

TERMING power planning "the reconciliation of all other war planning" because power "is used by all the war industries and all the soldiers and all the people," Chairman Leland Olds of the Federal Power Commission told the annual meeting of the Midwest Power Conference in Chicago that "if the tragic story of 'too little and too late' is repeated in the power field, the net result would be a delay in the production of vital war equipment, with an attendant loss of life and—quite possibly—of the war itself."

"This country," Chairman Olds continued, "is fortunate because it is strong in electric power—it is the strongest nation in the world measured in electric power. It is forunate that when the news of Pearl Harbor was flashed plans were already well along to assure adequate power supply for an overwhelming defense program. But that does not mean that the power problems of our war effort are solved, or that a self-satisfied, *laissez-faire* attitude toward further power planning can be tolerated."

Planning Wartime Power Needs Cannot Wait

Stressing that planning wartime power needs cannot wait until specific demands for power develop, Chairman Olds pointed out that the industrial picture may change in ways not now predictable, such as occurred in the loss of a source of rubber due to Japanese action in Malaya and the Dutch East Indies.

"It is not possible," he said, "to put into operation electric generating capacity with anything like the speed with which a need for power may arise. The time required to manufacture and install generating equipment under present conditions precludes any hope of securing more generating capacity in 1942 and 1943 than is now actually on order and it is even doubtful if this capacity will be available as scheduled. Yet, under war conditions, large industrial programs take form rapidly, progressing from the discussion to the operation stage within a matter of months. Furthermore, those planning the industrial program can estimate within narrow limits and can make necessary adjustments in time to avoid serious consequences. On the other hand, the results of low estimates for electric power requirements cannot now be corrected in less than 2½ to 3 yr."

Annual Energy Requirements

Chairman Olds told the conference that the Commission's long-range plan for power expansion presented to the President in July, 1941, which called for additional orders to bring generating capacity scheduled for installation in 1943 up to about 3,500,000 kw. and would assure continuation of new installations at the same rate through 1944, 1945, and 1946 was based on the assumption (1) that by 1943 defense expenditures should be running at an annual rate of $36,000,000,000; (2) that approximately half of this program would represent displacement of normal civilian supply; (3) that, even using manufacturing capacity to the limit, the total loads in 1943 and 1944 could be carried only by cutting heavily into reserves and by considerable civilian curtailment in certain areas; and (4) that if the war should continue into 1945 and 1946 provision would unquestionably have to be made for still further expansion on the defense effort.

"Now," he added, "we are at war. Pearl Harbor with all that it signifies, has brought the country face to face with that further expansion of the war production program. We cannot afford to wait until 1945 or 1946 for a program involving war expenditures at the rate of from $50,000,000,000 to $60,000,000,000 a year. We face annual energy requirements of about 150,000,000,000 kw-hr. for the war program, including direct and indirect war production as well as war service needs.

"For purposes of comparison we may recall that for the year 1939, before the defense program had gotten under way, the production of electric energy for public use was only 130,000,000,000 kw-hr. Assuming that war production will displace about half of the industrial production in that year for civilian purposes, there still remains the problem of assuring that by the time when the war program is in full swing it can command about 125,000,000,000 kw-hr. over and above those produced in 1939."

Additional Hydro Power Essential

Stating that arguments to the effect that additional hydroelectric power developments cannot be completed in time to be of service, that they require materials and man power otherwise needed for the war program, and that additional steam capacity could be provided more expeditiously or more economically to be "either attacks on the whole theory of defense power planning or a revival of the time-honored controversy between steam and hydroelectric power," Chairman Olds termed the development of additional hydroelectric power "an essential part of any adequate plan for war power supply."

Briefly reviewing the advantages which would result from the construction of the proposed St. Lawrence power project, projects on the Upper Ohio tributaries in Pennsylvania, the Clark Hill project in Georgia, and the grouped projects in the Arkansas and White Rivers in Arkansas, Mr. Olds said that "in general, all of these hydro projects as proposed can be constructed in a time comparable with that required, under present labor and priority conditions, for the installation of equivalent steam capacity."

Chairman Olds also stated that "it is certain that multiplication of steam generating capacity, as the war effort progresses, will face increasing problems of fuel supply. This will be due not only to increasing demand for the various fuels but probably even more to increasing pressure on the country's transportation systems. If, unfortunately, the war should prove long, the more water power that can be brought into the program, the less danger there will be of serious interference with power production due to fuel shortage. It is already apparent that transportation of fuels, both coal and oil, next winter will be a serious problem in some important areas."

Power Planning Based on Development of Regional Resources

"Power planning for war or peace," Mr. Olds said, "goes far beyond the limitations embodied in existing power and industrial facilities. It is fundamentally based on the development of regional resources to a sufficient extent to support a given war effort and the essential civilian participation. It envisages the possible construction of aluminum, magnesium, zinc, copper and machinery industries in new areas where suitable raw materials, transportation facilities and labor are available; selects the most probable of these possibilities and plans the installation of sufficient generating capacity to serve these industrial loads when and where they can be developed. Without such planning, industrial progress in the war effort may be limited merely by the inadequacy of the power supply.

"In terms of military strategy," Mr. Olds continued, "maximum utilization of local resources, best mobilization of man power, prevention of transportation congestion, etc., these expansions of the country's productive power may be located in areas not previously industrialized. The voice of private commercial interest no longer is decisive. As a result, war power planning must fully appraise the potentialities of all areas for development of war industry in terms of power supply which will make possible the placing of industries in presently rural or semi-rural communities."

Terming the recent annual statement of President C. W. Kellogg of the Edison Electric Institute as "extremely misleading report" which indicated "a generous paper surplus of generating capacity to carry the war load," Chairman Olds commented that "if such figures as he (Mr. Kellogg) offered should prevail, as a basis for planning power supply to meet the country's war needs, it would spell disaster."

Kellogg's Figures Too Low

Pointing out that the use of electricity corresponding with the 1941 defense expenditures of $12,531,000 was actually about 25,000,000,000 kw-hr. or about three and a half times Mr. Kellogg's figure of slightly over 7,000,000,000 kw-hr., Chairman Olds said that Mr. Kellogg's kilowatt hour figure was "entirely erroneous" and actually represented estimates of probable 1941 defense power requirements supplied to the Federal Power Commission in the winter of 1940 and Spring of 1941 for the production of finished materials for the United States Government.

"The estimates, in general," Mr. Olds said, "leave out the much greater requirements of the industries producing such raw materials as aluminum, magnesium, steel alloys, etc."

"Mr. Kellogg," Chairman Olds continued, "derived a ratio of sixtenths of a kilowatt hour per dollar of defense expenditures. It is interesting to compare this with such specific ratios as 66 kw-hr. per dollar for pig aluminum, 53 kw-hr. per dollar for magnesium, 72 kw-hr. per dollar for certain electric furnace process steel castings, 30 kw-hr. per dollar for electrolytic zinc, 50 kw-hr. per dollar for chlorine, from 7 to 10 kw-hr. per dollar for calcium carbide, caustic soda and other chemicals required in tremendous quantities for the production of the basic materials for explosives and 9 to 12 kw-hr. for ferro-alloys which are made in great quantities for the war program.

"Mr. Kellogg's ratio would result in an estimate of approximately 33,500,000,000 kw-hr. for the entire $56,000,000,000 war program. Actually, the production of aluminum and magnesium alone for that program will require more than 25,000,000,000,000 kw-hr."

Midwest Power Conference

Coal Research and the War Effort

By A. W. THORSON
Carnegie Institute of Technology

WHAT FUEL will you use in your plant if this war continues for several years? Why, you ask, raise that question when we live in a country that produces 40 per cent of the world's coal, 60 per cent of the world's crude oil, and consumes 2.5 thousand billion cubic feet of natural gas per year? This is why. Government authorities have already forbidden further installation of gas furnaces for domestic heating, and will undoubtedly encourage the operation of standby gas manufacturing equipment. Government orders have been issued, applying to 19 states, requiring conversion of power boilers from oil to other fuel wherever possible. These factors will increase the demand for coal.

Coal production is now at a rate of about 90 per cent of capacity. Wholesale and retail coal dealers, the National Coal Association, and the railroads have all advised their customers to stock up now while the capacity and adequate transportation are available.

Don't misunderstand; I'm not predicting a fuel shortage. But, we are at war, and we must prepare for the worst. Fuel supplies have been radically disrupted in

many nations. Research has anticipated many of these conditions, however, and has planned substitutes well in advance. Observe what our foreign friends and enemies have had to do.

ENGLAND

In England, domestic coal is now being rationed at one hundred weight per family per week. The London Times, January 9, 1942, reported that 10,000,000 t. per year could be saved by rationing, educating the public, and increasing the number of district fuel engineers.

The British Coal Utilization Research Association has been concentrating on improvement of availability of large boilers by reducing fouling of heating surfaces. Loss of output is serious owing to the unfamiliar fuels which power stations are obliged to burn. One large station has recently kept its boilers on the line 3 to 4 times the former period by operating stokers in a manner suggested by the small scale laboratory experiments. These studies indicate that impurities in the coal have much less effect on slag formation than the manner in which the coal is burned.

SWEDEN

Sweden's industrial coal and coke supply, principally imported from Germany, is now one-third normal. Enormously increased use of wood in the home and industry has critically reduced railway tonnage by transport of so much light material. Road transport and fishing vessels are using wood-burning gas producers. Production of 7200 B.t.u. per lb. coal and of oil from shale, both formerly uneconomical, are now under way.

RUSSIA

As the result of a far-sighted fuel research policy, Russia now has commercial gas supply by underground gasification of coal. The wood-burning gas producer, highly developed in Russia, now fuels military and industrial transport. The synthetic rubber industry has flourished for several years, using coal as raw material. Latest available figures show that in 1936 seventy million gallons of alcohol, partly from coal, went into rubber production. Recent reports show work to develop high grade metallurgical coke from low grade coal, anticipating loss of the high grade coking coals of the Donetz basin, which loss to the Germans has, of course, since occurred.

JAPAN

Japan's fuel situation is not definitely known. Production of synthetic oil and gasoline is reported, but the quantity is undoubtedly small. Latest coal production figures show 45 million tons in Japan proper. Manchuria produces some 15 million tons of coal per year, and some oil and gas. Coal from the North China fields, now in Japanese hands, is diverted to Japan to the extent that a local shortage exists. British reports estimate Japan had 12 to 14 months' fuel supply at the beginning of the war.

GERMANY

Research reports from Germany show, in spite of the war, progress in coal preparation; pulverized fuel combustion, briquetting, low and high temperature carbonization, byproduct recovery, gas purification and long distance transmission, high pressure hydrogenation, Fischer - Tropsch oil synthesis, producer gas for home and vehicular use, and liquefied gas for industrial vehicles. Diesel engines are now being modified to burn gaseous fuels, retaining 10 per cent oil for ignition with resulting equal or improved economy reported.

In the electric power field, the Germans are depending in the future on hydro as the principal source, and production concentrated in the large plants to reduce material and equipment needs. Some power companies are using coal dust and other plants are using Kramer mill firing. The latter show such high efficiency when burning waste fuels that no other type of furnace can compete. Sludge coals and washery middlings are successfully fired alone with ash up to 40 per cent, moisture up to 25 per cent, and volatile matter down to 16 to 18 per cent on dry coal basis. As far as possible, coal is being reserved for chemical treatment.

Looking critically at the foreign fuel situation, we know that most of these developments were germinated by peace time shortages. The war, however, has aggravated conditions and created new shortages, but these have been largely anticipated. Months and years of research have provided the means to carry on.

We in the United States have not been concerned with shortages, and many of us unfortunately are still unconcerned. Our research organizations, nevertheless, have and are continuing to plan for the future. Coal research is continually improving our use of coal and is discovering new products and uses.

For example, at the Battelle Memorial Institute, under the direction of R. A. Sherman, Bituminus Coal Research, Inc. is sponsoring improvements in domestic stokers, space and water heaters for smokeless operation with bituminous coal, pulverized coal-firing for industrial heating operations, improved methods of dust-proofing coal, improved coal-burning locomotive design, and an adaptation of the coal dust engine for pumping water.

The Pennsylvania State College, under the direction of A. W. Gauger, and the Illinois State Geological Survey, G. H. Cady, Director, are both working on domestic stoker design to broaden the range of coals for satisfactory use.

The U. S. Bureau of Mines Fuels Section, under the direction of the late P. Nicholls, has reported invaluable data on fundamental actions in fuel beds and on the relation between coal ash properties and clinker and slag formation. This work is familiar to all of you. The study of slag and its effect on furnace performance is progressing actively.

Hydrogenation of American coals, under the direction of H. H. Storch, is now in the pilot plant stage and the relative suitability of coals is being determined. Large numbers of materials can be obtained from the hydrogenation or liquefaction processes, and conceivably the vast amount of research on this subject at the Bureau and elsewhere may pay dividends sooner than was originally anticipated.

The Coal Research Laboratory at the Carnegie Institute of Technology, under the direction of H. H. Lowry, is studying methods of controlling blast furnace coke quality for the purpose of increasing output of iron; the mechanism of combustion of pulverized coal with a view toward reduced furnace volume requirements and control of slagging. The Laboratory has just been issued a patent covering a high duty multiple retort underfeed stoker designed to burn coal at a rate several times the present maximum. The Laboratory is discovering new coal derivatives by hydrogenation, solvent extraction, and mild oxidation. The latter studies have shown that products such as sod-

ium oxalate, which is used in incendiary bombs, plasticizers for synthetic rubber and new plastics, all critical war materials, can be made directly from coal.

Gentlemen, we must win this war! Fuel must produce before power can begin. Power must produce before manufacturing can begin. Manufacturing must produce before MacArthur can succeed. That gives us a pretty important role, doesn't it? What can we do? How can we contribute most effectively? Here are some things each of you power engineers can and should do.

Stock fuel to the limit of your facilities. Conserve your maintenance supplies. Above all, keep your plant capacity in operation. Study your fuel supply and anticipate your problems in attempting to maintain capacity with a second or third choice fuel. Here our equipment service, fuel service, and research engineers come in. They have knowledge of the critical properties of fuels and their application to your equipment. Call on them, take advantage of the help they will gladly give. With such cooperation POWER will win this war.

Midwest Power Conference

Maximum Output From Boiler Plants

BY E. G. BAILEY
Vice Pres. Babcock & Wilcox Co.

STATIONS now operating must supply nearly all of the power needed to see us through this war. Plants formerly operating with comfortable capacity factors probably will be stepped up close to, or beyond, the 100 per cent mark. This means intelligent inspection, repair and operation.

Nothing decreases output so seriously as emergency or unscheduled outage. A boiler or power unit dropped suddenly and unexpectedly from service usually means dropping load or shifting it to some other unit or system. As each system reaches its full capacity, curtailment of output must follow such outages.

Observations indicate that as stations become more heavily loaded, the likelihood of forced outages becomes greater. This need not necessarily be true; in fact, it does not happen that way in all stations. In some, troubles seem to re-occur with such frequency that there must be a cause, and therefore a remedy. The human being is adept in finding or manufacturing alibis; it often condones the right to make a mistake once. But that is not good engineering; and it is unpardonable under existing conditions. We have engineering publications, technical societies, and meetings in various parts of the country at reasonably frequent intervals to frankly tell others of our accomplishments, and sometimes, but too seldom, of our mistakes and shortcomings, so that others may benefit by avoiding these later.

Speaking particularly of the steam generating unit in the power plant, there are many important things taking place within the pressure system which cannot be seen while operating. There are numerous meters and instruments available to visualize and record many important factors which formerly were entirely unknown, such as steam output, draft loss, conductivity of boiler water indicating concentration, etc. None, however, can definitely indicate scale formation, corrosion, and many other conditions which can only be determined by periodic internal inspection.

The most frequent forced outages of boler units are those due to tube failures or leaks at tube seats or handhole fittings. Some of the more frequent causes for such failures are: 1. Improper feedwater treatment, with resultant scale or sludge, causing overheating of tubes. 2. Faulty boiler or waterwall circulation. 3. Priming or carryover to superheater and turbine. 4. Leaks due to thermal stresses resulting from too rapid temperature changes. 5. Corrosion or tube wastage, internal or external. 6. Cutting of tubes by soot blowers. 7. Low water.

Fuel Burning

There are perhaps as many, if not more, factors affecting reliability, output, and efficiency, in the fuel end of a steam generator than in the pressure parts. Experience has indicated that the fuel problems result in less total outage, but they may account for more reduction in output than those having to do with pressure parts of this boiler unit.

Many operators may encounter more new problems and need more help on fuel than on feedwater and the boiler itself, because many have already changed, or will have to change, from gas or oil to coal. Others may have to change from their present coal supply to a new or a variable coal supply, which may not be so good. Those having to use a variety of kinds of coal should follow its analysis closely and perhaps accomplish some surprisingly good results by properly mixing or blending such supplies.

Furnace Explosions

A little carelessness in lighting a furnace may cause serious damage to life and property, and a long and expensive boiler or plant outage. While this may seem just as elementary as low water, I make no apologies for emphasizing furnace explosions, because they still occur more often than seems excusable, with real disaster. The frequency and damage are greatest with gas and oil. Next comes pulverized coal. Here the trouble is often with the gas or oil lighting-toreh system, but occasionally rises from the coal itself. Explosions seldom occur in stoker or hand-fired boiler furnaces, although occasionally gas is generated in such quantities that dead pockets form and become ignited.

Detailed instructions on prevention of furnace explosions will not be given here, but such instructions can be found in an earlier paper presented in 1937.[1]

[1] "Prevention of Furnace Explosions," by E. G. Bailey, presented before the Eleventh Annual Meeting of the Board of Boiler & Pressure Vessel Inspectors, "Power Plant Engineering" August, 1937.

"Furnace explosions cannot occur upon lighting if:

1. The furnace is purged of all fuel.
2. Ample torch flame is properly applied to each burner before fuel is turned on to each burner in succession.
3. Air velocity at each burner is kept low enough to prevent blowing out the flame.
4. Fuel is supplied in a sufficiently rich mixture to immediately ignite from the torch.
5. After ignition is established, the correct proportion of fuel and air is maintained through the entire time furnace is in operation, and, if the furnace is operated at a high enough rate to maintain stable ignition."

Electric eyes, interlocks and protective devices are rapidly being perfected to a high degree of reliability and usefulness in this particular. With or without them, intelligent carefulness is needed at all times.

Ashes, Clinker, Slag;—Cleaning and Removal

Ash in coal has always been recognized as one of the major hindrances to obtaining the maximum output and efficiency in the use of coal. The characteristics of ash are often the predominant factor in selecting coal for a given purpose. It has been easier and cheaper to buy both stoker and pulverized-coal fired units of the medium to small capacities adapted to the higher fusing ash coals. Such coal is now commanding a premium over coal with lower fusing ash.

Not everyone fully realizes how much progress has been made in perfecting designs of steam generating units to burn successfully the low grade coals. Many plant operators will probably be well repaid during the next few years for their foresight in selecting equipment of the advanced designs.

There are many installations of the older or more limited design where difficult problems will be faced from ash and slag as ratings are increased or coal of less adaptable characteristics must be burned.

In fuel beds, much trouble from clinker can be avoided by maintaining uniform and relatively thin fuel beds with equalized distribution of the correct amount of air. Zones of excessive reducing condition which result in more fluid and troublesome clinker, especially with coal ash higher in iron, should be avoided.

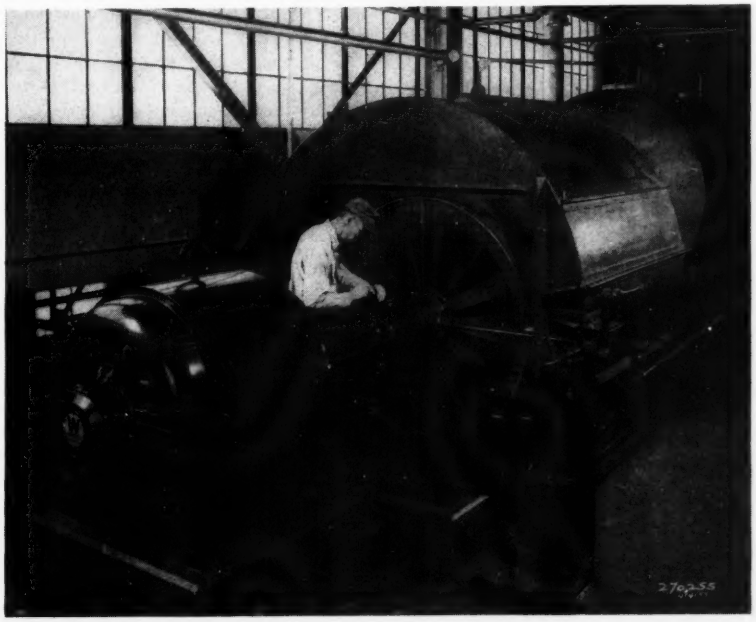
Pulverized-coal-fired furnaces perform better in every way when the coal is finely pulverized, and mixed uniformly with the correct amount of air. Fine pulverization cannot be stressed too strongly, especially with respect to the 50-mesh size. It pays to check each pulverizer regularly with fineness tests.

The proper distribution of coal and air at burners and in the furnace should be checked by weighed coal collections at burner, and by analyzing gases of combustion in the furnace from near the burners on through the furnace and boiler. This requires suitable water-cooled gas-sampling tubes and gas-analyzing equipment for oxygen and CO in addition to the usual CO_2 determination.

A great deal has recently been learned about the effect of excess air on slag conditions throughout a furnace and boiler unit. Excess air affects furnace temperatures, as well as the fusing temperature of the slag and fly ash. Higher excess air actually results in the ash and slag collected on the walls and the tube banks being of a higher fusing temperature than if the excess air were lower. This means that the actual slag and ash accumulation in many furnace walls and tube banks is higher by 100 to 400 deg. F. than the usual laboratory standard determination, which is done in a reducing atmosphere, while in zones of low excess air the slag fusing temperature may be as low as the laboratory results, or even lower due to a segregation which causes the iron content of the ash the greater are these effects, which result largely from the differences in the oxides of iron.

Even after taking all precautions possible there still will likely be slag cleaning problems to face. Many recent boiler units are so arranged that a reasonable number of retractable blowers keep the unit in a satisfactory degree of cleanliness with the expenditure of very few man hours. More hand lancing may be needed throughout all parts of some boiler units if high temperature alloys needed for soot and slag blowers are greatly restricted.

Outages of slag-tap furnaces are occasionally caused by slag leaks, or leaks of the water-cooling tubes around the tap hole. Slag leaks usually result from the erosive nature of molten iron-sulfide when it accumulates on the floor underneath the regular slag. This sulfide, and sometimes metallic iron, are the result of coarse pulverizing, deficiency of air, or maldistribution from burners. Some types of floor construction are better safeguards against leaks than others, but in many cases the leaks are caused by insufficient care being given to construction details at corners.



Typical of modern large boiler room practice. A 300-hp. 1200 r.p.m. 2300-v. motor driving an inlet vane controlled fan in the Toronto Station of the Ohio Edison Co. (Photo, Westinghouse.)

Efficiency

Most plants have meters and instruments, and many have automatic control. For the best results all

of this equipment must be systematically checked, and adjusted if necessary. Often this equipment is of great value in keeping conditions correct for maximum output as well as best efficiency, and is also assurance against serious accidents due to the failure of pumps, fans, or other major equipment.

The present tendency is duplication of design for any units now being installed. We are approaching a good shakedown period during which the relative advantages and disadvantages of the many varied units recently designed can be learned if proper records are kept and proper comparisons are made. This should lead to better units in the future with a trend toward standardization.

Co-operation between operators, designing engineers, consultants, fuel suppliers, insurers, state inspectors, and manufacturers' engineers and service departments, will do a great deal to obtain the maximum output from existing power plants, and at the same time obtain best possible efficiency, thereby conserving fuel.

Gas and oil may be restricted or become entirely unavailable in certain areas, and to certain users at least. Changing to another fuel often raises problems that can best be solved with the cooperation of the manufacturer of the fuel-burning equipment, and the combustion engineers of the company supplying the fuel. I am quite sure they will all be willing to co-operate fully to the limit of their depleted personnel.

I am sure that every one of us appreciates how important it is that we exert our utmost to keep the country's power plants operating at their maximum capacity for the duration of the war.

Midwest Power Conference

Production Testing of Aircraft Engines

By C. A. CHAYNE
Chief Eng., Buick Motor Div., G. M. Corp.

WHEN AN AIRCRAFT engine is delivered to a plane manufacturer, it must be ready to go to work at once. There is no such thing as flying a plane slowly for so many miles or hours until the engine is run in, which is the way we are all accustomed to breaking in a new car. The first thing that a new aircraft engine is required to do is to operate at maximum power in order to get the plane off the ground and into the air. After this has been accomplished the engine may then be throttled back to cruising speed and perhaps treated with more than usual care until the plane has been landed and is ready for another take-off.

With this in mind you can see that we must not only deliver the engines ready-to-run but they must also be thoroughly run-in and ready to go to work. The job that must be done in the test department of an aircraft engine plant is to take the engines as they are delivered from the manufacturing department, run them in thoroughly, and check all phases of their performance.

Performance Tests

This work may be divided into six phases. The first phase consists of running-in the engine for a sufficient length of time and under a sufficiently wide variety of loads and speeds to insure that all parts are operating smoothly. Different manufacturers have adopted different methods of carrying out the running-in phase, some operate the engines at all times under their own power, others drive the engines by an electric motor for part of the time and run them under their own power for the remainder of the schedule.

The second phase is a preliminary performance check to determine if the engine performs close enough to specifications to justify proceeding with the remainder of the standard schedule. If the engine is not performing properly, then it is necessary to decide what checks should be made to locate the difficulty and correct it.

After this much of the schedule has been carried out, the engine is then returned to the manufacturing department where it is completely torn down and all parts inspected. After this inspection the engine is re-assembled and returned to the test department for the final testing.

The next step is what is commonly termed a shakedown run which is of several hours' duration and is designed to give the engine sufficient running after the re-assembly to put it in shape for the last step which is the final acceptance test.

Test Equipment

In general—there are three fundamental types of test equipment which may be used for this sort of work.

First, the propeller house; second, the absorption dynamometer; and third, the feed-back system. The latter was developed into practical form by one of the old-line aircraft engine manufacturers and is the type we have adopted because it is the only one which offers any sort of a return for the money spent for gasoline. Another advantage is that the installation is somewhat less costly than properly designed and equipped propeller houses.

Figure 1 shows arrangement of the fundamental units used in the feed-back equipment as installed in our plant. At the right of the assembly is the engine which drives, through flexible shaft couplings, a magnetic coupling of the eddy current type. This unit permits us to run the engine at whatever speed desired—maintaining all the while a constant speed on the output shaft of the coupling. The next unit is an air operated brake which is mounted on the output shaft of the coupling. Next we have a large alternator of sufficient capacity to absorb all the power the engine is capable of developing and finally at the end the field exciter for the alternator.

The alternators in our installation are of two types. The reason for this has nothing to do with their performance. It was solely for the purpose of dividing the business and permitting us to get the equipment in the time required.

One type is a 1200 kv-a. unit with a power factor of 0.8 while the

second is a 1000 kv-a. unit with a unity power factor. The 0.8 power factor units may be idled on the line as synchronous condensers when they are not being used for testing in order to keep the overall power factor at as good a figure as possible. Figure 2 is a photograph of one of the installations.

Test Procedure

The alternators are started by metal-clad air circuit breakers which are located in a master substation outside the main building. In the cabinets, which you see in the picture, are located the relays controlling the field excitation.

The magnetic couplings are water-cooled units of a standard type and have sufficient capacity to transmit the maximum torque of the engine. For obvious reasons the couplings and the alternators are mounted on a common steel base. One of the features of this type of slip coupling, which has proved extremely satisfactory in use, is the method provided for controlling the speed of the engine. The field of the coupling is equipped with electronic tube control and there is an alnico generator on the input shaft which is in the grid circuit of the electronic tubes and provides a constant speed control. The advantages of this system are very important because it is possible to set the controls for a given engine speed and within very wide power limits the test operator may confine his activities to operating the throttle in order to get the desired manifold pressure, he does not have to re-adjust his load control every time he moves the throttle lever even a slight amount.

On feed-back installations used previously, fluid couplings were used where we have used the magnetic coupling and while they provided an acceptable means for controlling the engine speed it was not possible to develop a constant speed control, furthermore, they required an elaborate system of oil circulating pumps and heat exchangers for their operation. While our magnetic couplings require an electrical control which is rather staggering at first glance to us mechanical engineers, nevertheless the system has proved to be very uniform in operation and despite the fact that it was an entirely new type of installation we had relatively little difficulty in ironing out the few "bugs" which showed up at the start.

Now—let us consider how this equipment is used in the actual testing of an engine. After the engine has been installed on the test stand and is ready to go to work, the alternator is brought up to speed before the coupling is energized. As soon as the alternator is on the line the coupling is energized just enough to crank the engine over slowly. As soon as the engine fires the coupling is de-energized and the alternator cut off the line. As the alternator has considerable inertia, the air brake may be used to bring it to a stand still quickly. After it has been stopped the brake is used to lock it stationary. Under these conditions the coupling may again be energized. It then functions as an eddy current absorption type dynamometer, permitting the application of load to the engine at speeds below the synchronous speed of the alternator. Under these conditions, of course, the power developed is transformed into heat which is carried away in the cooling water of the coupling.

When the schedule calls for engine operation at speeds above synchronous speed, the brake is released, the alternator brought back on the line and the coupling speed control used for the remainder of the test to control the engine speed.

These steps which sound very simple involve quite a few moves in the various electrical units, but as far as the test operator is concerned the operation is simple and since we had to start in with green operators who had never tested an expensive piece of machinery, such as an aircraft engine, I think you will agree with me that the simplicity of operation is extremely important.

Safety Provisions

The safety devices on the coupling units are: first, an overspeed safety which shuts off the ignition system of the engine should its speed rise above a predetermined figure; second, the cooling water supply to the coupling must be turned on before the coupling can be energized and if the water supply should fail during a test the coupling excitation goes off and the overspeed safety cuts off the ignition; third, if the operator should carelessly try to apply the air brake at a time when it should not be applied the coupling is de-energized and the alternator is tripped off the line and again the overspeed safety shuts off the engine.

The alternators are equipped with overspeed safeties—with relays in the field circuit which disconnect the alternators if the field excitation is lost and also with relays which disconnect the alternators if the frequency exceeds or drops below predetermined limits.

In addition to these various safety devices on the electrical equipment, we also have others which either shut off the ignition or flash a warning light or blow a horn if, for instance, the automatic fire extinguisher system in the test cell goes into action or if the exhauster fan which scavenges the cooling air and exhaust gases out of the cells shuts down, or if the oil pressure on the engine drops below a certain value.

Features of Test Department Building

Referring again to Fig. 1, which shows a section through a portion of our test department building, it will be noted that at

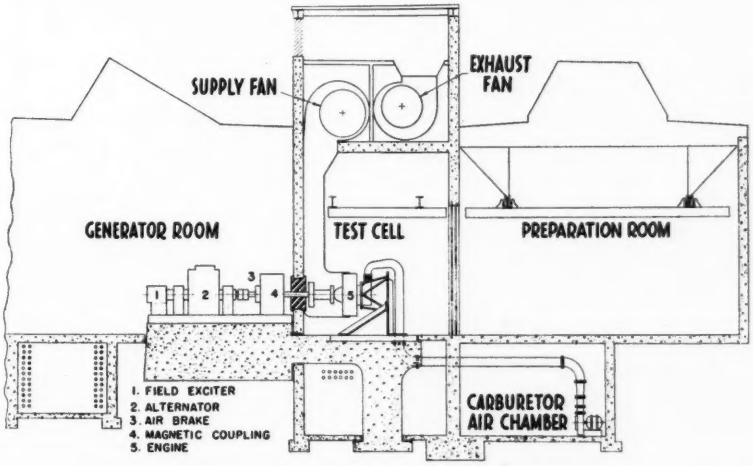


Fig. 1. Section through portion of test department Building

the right is what we call our preparation room. The engines are brought into this room from the assembly department on monorail units and are installed on the stands on which they are supported while under tests. All the fittings and connections are installed in this room and after the engine is completely "dressed up" the engine and stand assembly are picked up by the monorail unit and carried into the test cell. The assembly is then dropped down in place on the bed plate, the shaft coupling bolted up, and the connections to the test stand instrument, oil and fuel lines rapidly made by means of snap-on couplings of various types.

Below the preparation room is a corridor extending the full width of the department which is air-conditioned and in which are located a series of blowers, each of which supplies air through a venturi air flow meter to the carburetor of an engine. This room is kept locked so that unauthorized persons cannot enter it because the air intake of an engine is the most sensitive part of the unit and you can easily see the possibilities of trouble if this room were not locked. By conditioning the air in this carburetor air chamber we are able to reduce the corrections necessary in calculating our engine performance.

The test cells themselves are square rooms with heavy concrete walls and with double refrigerator-type access doors. A noise seal is used where the coupling shaft projects through the wall of a test cell. As a result of this design the noise level in the department is very satisfactory.

Immediately above the test cells is located a penthouse containing the supply fan for cooling air and an exhaust fan which scavenges the test cell. Inlets and outlets of these fan rooms are equipped with generous sound-proofing and as result the noise level outside the building is very satisfactory.

Foundation Separate From Main Building

You will notice that a common concrete foundation is used for both the engine test stand and the power absorption equipment. This foundation is completely separate from the walls and floors of the main building and because of its large size and the weight of the units installed on it, it has very little vibration.

The corridor immediately under the test cells contains the multitude of pipes necessary for supplying oil and water and for connecting the many instruments and gages in the control rooms to the engines on test. The tunnel at the left of the picture carries the electrical connections from the alternators to the master sub-station.

One characteristic of this building design is that we have all of the power absorption equipment in a large well lighted and well ventilated room rather than housing each individual unit in a small room in such a way as to make it difficult to get at when servicing operations are required.

Feed Back Serves 85 Per Cent Energy Change

Since we have only been in operation a few months I cannot give you any performance figures on this equipment based on what could be termed "normal operation" because we started our operations with one cell and as each additional unit was completed it was "shaken down" and then put into the production line-up. This process, by the way, is still going on and because of the size of our operation will continue in that state for sometime to come. We have, however, accumulated a few figures, given below, over a time interval long enough to insure that they represent a fair picture of what can be accomplished under present conditions.

Energy used .....1,510,000 kw-hr.
Energy generated..837,000 kw-hr.
Energy bought.....796,800 kw-hr.
Total generated
and bought ....1,633,800 kw-hr.
Energy returned ...123,800 kw-hr.
Generated energy used.....85%
Energy charge saved.....68%

In view of our experience, I think you can rest easy at the prospect of engine plants which may locate in your own territories installing equipment of this type and I am sure that it is of vital importance that engine manufacturers be encouraged to use "feed-back" equipment because of the assistance such equipment will prove to be in relieving the power shortages of which we hear so much today.

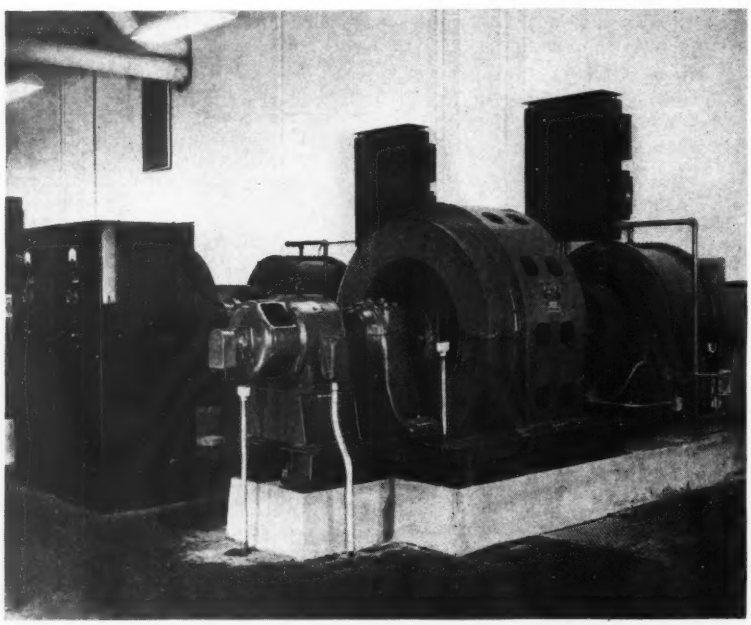


Fig. 2. Permanently installed testing equipment. Engine under test occupies cell back of wall in background

LOW COST MODERNIZATION SOUGHT IN MOLINE PLANT EXTENSION

IN THE ARTICLE *under* this title in the April issue, the turbine in the list of equipment on p. 56 was, by mistake, credited to the wrong company. The complete turbo-generator unit was manufactured by the Westinghouse Elec. & Mfg. Co. It is a single cylinder, single flow, non-automatic bleeder, condensing machine designed for 825 lb. ga., 825 deg. F., 1 in. absolute back pressure and for the extraction of 200,000 lb. per hr., 215 lb. ga. steam. It drives a 15,000 kw., 0.7 p.f., 3600 r.p.m., 13,800 v., 3 ph., 60 cy. air cooled generator.

Midwest Power Conference

Prevention of Steam Losses and Fuel Waste

By V. G. LEACH
Chief Comb. Eng., Peabody Coal Co.

THIRTY-FIVE MILLION tons of fuel or more are going to be wasted in this country in 1942. In 1941 the average coal miner produced 5.2 t. of coal per day on this basis, a saving of 35,000,000 t. in 1942 would be equivalent to 6,634,000 man days or would free 22,000 men for other war effort and would release 28,000 coal cars which are at this time so sorely needed.

With the growing demands for power, for heat, for transportation facilities, and for labor, everything practical should be done to prevent waste and to conserve fuel. If there is anything that needs to be encouraged, it is frequent plant inspection by competent combustion engineers. It is no less important to call in outside engineering counsel than it is to retain legal aid or to have auditors to check our books.

Status of Equipment

According to a recent report of the Chicago Department of Smoke Inspection and Abatement, 26,785 boilers were inspected the first nine months of 1941. As a result of such inspections, 9,248 repair notices were sent to building owners. Since January 1, 1940, the Department has sent out over 25,000 repair notices.

W. E. Tidmore, director of the Smoke Abatement Bureau in Atlanta, Georgia reports that the Department is making recommendations on over 90 per cent of the plants inspected—that over 50 per cent are in need of serious repair—that they must be reconditioned before they can be fired efficiently and smokelessly. Some plants, he says, are in such condition that they are a distinct fire hazard.

Koppers Coke inspected 12,116 heating plants last year; their service man sealed leaks in 11,545; installed 896 dampers and air checks. They reported only 571 furnaces or 5 per cent in "satisfactory" condition.

In the large, industrial field, conditions are immeasurably better, but even here from 10 to 30 per cent of the plants—depending on the size or load—need attention, alterations, or repairs.

Utilities lead the procession in efficiency. Equipment is in excellent condition—superlatively maintained and operated.

Undoubtedly the first item of importance is maintenance. Obviously no equipment can function efficiently in a broken down condition. Too many plants have been allowed to degenerate into mere junk heaps during the past 10 yr.

Cost accounting is a potent factor in preventing steam losses and fuel wastes. The boiler plant often spends more money than any other department, yet in the majority of instances, particularly industrial plants, very little check is made on the efficiency with which this money is spent. Instrumentation becomes increasingly important as the consumption of coal increases and is of course intimately tied up with cost accounting.

The problem of securing competent plant operators is a serious one. During the depression years the professional plant operators in many plants disappeared, having been replaced by lower salaried and inexperienced employes. However, the difference in payroll between competent and incompetent plant crews is often trivial compared to the difference in the cost of steam which also includes such items as maintenance, outage, and replacement.

Another result of the depression years was neglect of the plants. It has been estimated that during the last 15 yr. about 75 per cent of the boiler rooms in this country have been neglected. Not a dime was spent in the majority of cases where it could be avoided. Breakdowns alone were responsible for most of the maintenance and repair expense. Only light loads enabled many plants to "get by." Only the skill of some of our "old school" firemen and engineers kept thousands of plants going. Only the readiness of coal producers to furnish refined coal and special sizing, permitted thousands of other plants to carry the load. Only the availability of the coal operators or railway company's fuel, enabled thousands of plants to meet operating difficulties.

In the manufacturing and industrial fields, the larger plants in general, are in relatively fine condition. As the plants decrease in size, the condition of the boiler rooms become progressively worse, more in need of repairs, overhauling, and modernization. Of the 184,000 manufacturers in this country, the chances are that 20 per cent have heating power plants that are in excellent condition, that 50 per cent are in "fair" shape, and that 30 per cent are in serious need of attention, repairs and alterations.

What the Coal Industry Is Doing

The coal industry is studying the problem of fuel waste through intelligent engineering analysis and extensive research.

Changing our coal screening plants into highly organized coal refineries. These coal refineries produce special grades and sizes of coal particularly suited to meet increased steam demands on both modern and antiquated types of equipment. Many industries today, to whom new equipment is denied, are nevertheless meeting their war time needs with prescription fuels from the coal refineries.

A salient feature of the coal refining process is the elimination of approximately one-third of the ash content of the coal. This means that bone, clay, shale and pyrites, which constitute from 4 to 6 per cent of the total production, is no longer shipped to the ultimate consumer. This represents a very substantial saving not only in railway facilities but also in increased plant capacities and lowered plant maintenance.

Midwest Power Conference

Results With Spreader Stokers

BY R. N. BUCKS
Supt. Power Plants, Studebaker Corp.

EARLY in 1940 the large increase in production of Studebaker automobiles, particularly the Studebaker Champion, required 120,000 lb. more steam per hour. This need for additional steam to heat the enameling ovens was the main reason for increasing our steam generating capacity.

Gas firing was considered for the ovens, but a survey showed that gas equipment would cost $70,000 more than the new steam unit, and the cost of drying with gas would be $67,500 more per year than with steam, so the decision was made in favor of steam.

Experience during the first World War made the management insist that this unit be designed to burn any available coal, particularly the nearby low grade Indiana and Illinois screenings.

The boiler house was already built. Some old 500-hp. boilers had been removed from one end of the boiler-room, so by taking out every other building column we could get space to give us a maximum furnace width of 24 ft. and a maximum furnace length of 16 ft. 8 in. The newer boilers in the plant were 1500 hp. and were installed in this same space between building columns. These boilers were capable of delivering 100,000 lb. of steam each with good coal. In this same space, with approximately only 400 sq. ft. of grate surface available, the new boiler would have to supply 175,000 lb. of steam continuously and 210,000 lb. for 4-hr. peak loads.

We went at the problem backward by designing the furnace first and building the boiler around it. We could not make the space wider; we could not stretch it longer; we could not go down, but we could go up through the roof.

CONVERSION: AMERICA'S JOB. Labor's Part. Like 2,000,000 other workers, this employe has become a more valuable cog in America's war machine because of instruction and practice that have increased his skill. Because of the shortage of skilled machinists, workers are being "upgraded" — trained for more skilled work—all along the production line. Training-within-industry is sponsored by the War Production Board. (Photo, OEM)

Normally we could figure on 11,500 B.t.u. coal as fired, but we had to be sure that we could still get this steam with any coal as low as 10,000 B.t.u.

With only 400 sq. ft. of grate surface available it meant we would be obliged to burn over 50 lb. of coal per sq. ft. of grate per hour to develop 175,000 lb. of steam continuously and 65 lb. per sq. ft. per hour for 4-hr. peak loads. These figures were based on 11,500 B.t.u. coal.

Our first selection of equipment was the Detroit RotoGrate Stoker, a spreader stoker with continuous ash discharge. We not only tackled this problem backward from an engineering standpoint, but we also selected a stoker that runs backward, for this traveling grate discharges the ashes at the front end of the boiler directly below the coal feeders. Previously all large stokers have discharged the ash at the rear end of the furnace, just the reverse of this stoker. The stoker has six overthrow coal feeding units mounted at the front of the boiler that spread the fuel evenly over the entire grate surface, the rate of feeding being varied automatically in accordance with the load. The ash is always at the bottom, with a thin fire on top, so that the grates are insulated from the heat of the furnace by this ash bed and are cooled by the forced draft air supply.

We literally built a boiler around this decision, selecting a Foster-Wheeler 3-drum boiler with 45 per cent black surface in the furnace. Heating surface in the boiler proper, 18,800 sq. ft.; water walls, 2620 sq. ft.; economizer, 4608 sq. ft. Design pressure, 275 p.s.i.; operating pressure, 225 p.s.i. Steam temperature, 520 deg. F. Feedwater temperature leaving economizer, 256 deg. F.

An American Blower Co. cinder separating induced draft fan was installed. An air operated fly-ash reinjection system returns all fly-ash to the furnace so it is finally

discharged with the ashes from the grates to the hoppers below.

Bailey combustion control of the air flow-steam flow type is used, together with a full complement of instruments, flow meters, draft gages and CO_2 recorder.

To get adequate furnace volume we pushed the boiler right up through the roof, setting it 21 ft. from center line of mud drum to firing floor, with an average distance of 30 ft. of flame travel to the entering tube surface, and providing 9700 cu. ft. of furnace volume, which is a heat release of about 29,100 B.t.u. per cu. ft. at peak load.

The new unit was put on the line November 11, 1940, and has operated practically continuously since. No changes have been made in the original design. There have been six outages of two days each for inspection and cleaning.

We have burned more than 50,000 t. of coal with the unit. Coal is purchased in 100 car lots and has come from six different Illinois and Indiana mines. With the exception of burning a few cars of 14,000 B.t.u. West Virginia coal just to see how it would work (and it performed beautifully), all of this coal was 1¼ in. by 0 raw screenings, or smaller sizings. No prepared sizes of washed or dedusted coal have been used, only the cheaper raw screenings.

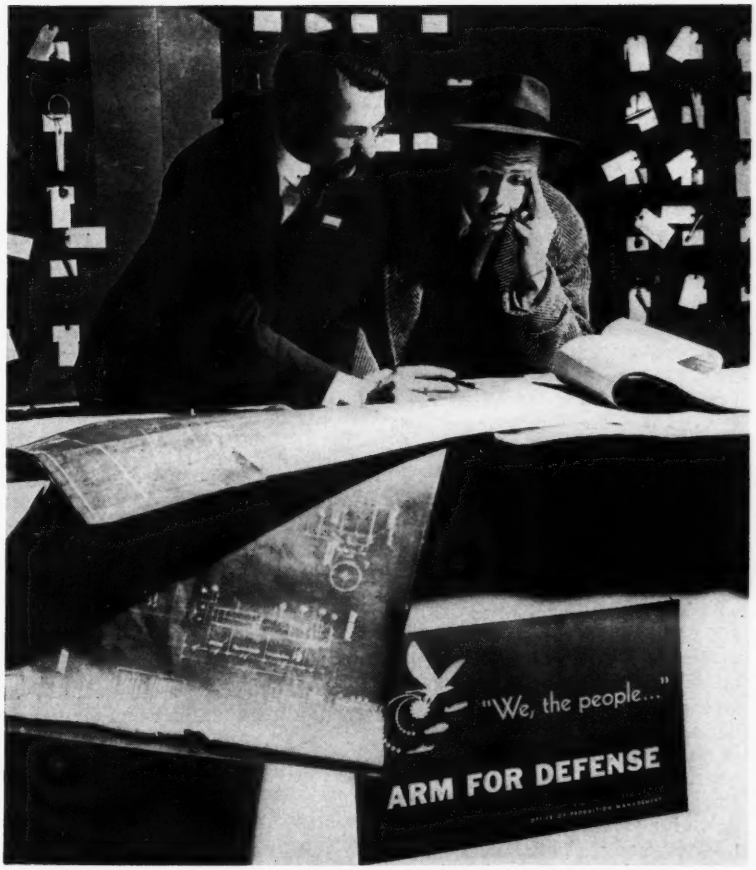
For the year of 1941 the annual efficiency, including stand-by losses, corrected for blow down, and covering a load range from 35,000 lb. of steam per hour to 225,000 lb., was 82.4 per cent. The monthly efficiency varied from 80.5 to 84.4 per cent, dependent, of course, upon the plant load. We believe this high efficiency can be obtained because the fuel bed is never disturbed and this bed is maintained constantly and automatically under what amounts to practically test conditions.

The average coal analysis for the year was approximately:

Volatile	36 per cent
Carbon	40 per cent
Moisture	10 per cent
Ash	14 per cent
Sulphur	4 per cent
Point of fusion	2,000 deg. F.
B.t.u. as fired	11,000

The following annual average data will be of interest:

CO_2 in furnace .....14.5 per cent
CO_2 at boiler exit....13.5 per cent
Gas temperature to economizer 531 deg. F.
Exit temperature to stack 423 deg. F.



CONVERSION: AMERICA'S JOB.

What Everybody Can Do. After studying the hundreds of bits and pieces of needed war products at the subcontracting exhibit sponsored by Contract Distribution Division of the War Production Board in St. Louis, this plant manager studies the detailed specifications of a part he believes he can handle on his machines. (Photo, OEM)

Coal cost per ton.....$3.25
Cost per 1000 lb. of steam....18.7c
All of the figures quoted are the annual average and are results actually obtained over the entire year of 1941.

In just 1 yr. of operation we feel that the entire unit has paid for itself over estimated cost of gas fired dryers. Over the cost of producing steam from the 1500-hp. boilers fired with underfeed stokers and pulverizers our actual saving in coal has been more than $75,000 during the year of 1941.

During the year we found we were able to operate 24 hr. continuously at 225,000 lb. of steam per hour with a coal that analyzed 10,049 B.t.u. as fired, 16 per cent ash. That is a coal burning rate of 80 lb. per sq. ft. of grate per hour.

Boiler maintenance has been nil. Stoker maintenance has been about 5 cents per mo., and we mean 5 cents per mo., not per ton of coal. Sixty cents worth of shear pins has been the total maintenance cost since the stoker was started.

An inspection of the grates shows no evidence that they were ever used. When operating at maximum capacity one can scoop a handful of ashes from the discharge end of the grates. They are not even hot. One can lay one's hand on the grates themselves at this point. The ash is loose and granular, practically no clinkers. Combustible in the ash averages less than 2 per cent.

We were glad to find that the cinder separating fan did a good job so that there is very little fly-ash accumulation in the stack base, nor have we had any noticeable fly-ash around the plant.

We feel that our company now has nothing to fear on what might happen to the fuel market during the war. If the coal will burn, we can burn it.

WAR EFFECTS

Excerpts from C. W. Kellogg's* address before the Missouri Public Utilities Association at St. Louis, April 14, 1942.

It appears that orders have been issued by the Navy to manufacturers to discontinue work on about 1,000,000 kilowatts of turbo-generating equipment ordered for 1942 completion by the electric utilities, so that this equipment can be used for ship propulsion purposes. I do not pretend to say whether this is an indication of how desperately ships are needed or of how relatively satisfied the Navy is about the ability of the power supply of the country to care for the war industrial requirements. In any event, the stress of war preparation has made academic the question of what should be installed in the way of additional electric generating capacity and has substituted for that question the very practical one of making the most effective use for defense of what we have. But this is no more than the old Priorities question stated in another way. This change in emphasis from a drive for capacity to the maximum use of what we have, has brought another change in its train. A year ago a given city or section might speak with satisfaction of the amplitude of its generating capacity to care for any foreseeable war loads. Today such a situation, if it existed, would promptly have loads brought to it to utilize the spare capacity. In a word, excess capacity acts like a vacuum, which becomes quickly equalized by the general surrounding pressure of war industrial demand.

Our power sales force must be so familiar with the requirements of each of their power customers as to be able to help effectively in arranging for such shifts in hours or manufacturing schedules as will make the existing supply of generating capacity produce the maximum of useful kilowatt-hours. We must be in the position, from planning beforehand, to know exactly how and in what order, power users must be kept off the peaks, if power rationing, when it comes, is to be confined to the smallest possible area for the shortest possible time. By doing this successfully we shall not only help our country to obtain the maximum of war production, but can build up for the future a feeling of mutual confidence with our power users. I should expect the War Production Board to use our operating and commercial men to the utmost in handling power allocation in each locality where that may prove to be necessary. This has already been done in a very effective way during the water shortage in the Southeast last summer and fall. The government men found the utility men so ready and willing to assist that the final totals of energy delivered to the power stricken area from the outside were greater than had been expected.

We must not be led into a false sense of security about the power situation from developments to date. It is true that in recent weeks the rate of growth in energy output over the previous year has slowed up compared to what it was six months before. This was to be expected from the loading up of the plants built by the Government pursuant to the original defense program and from shutdowns pending transition from civilian to war work. With our own entry into the war, there has been a vast expansion in the scope of the war effort; but the full effect of this in power consumption cannot occur until the completion of the new and larger war industrial plant required to produce this larger output. Now, before the pressure is on us, is the time to prepare ourselves for the solution of the problems I have mentioned of adjustment between war and civilian activity which will be upon the country in the latter part of this year.

I have only to remind you that the military reasons for placing our new war plants as far as possible from our borders have caused a much greater proportion of such new plants (and therefore the power to run them) to be located in Missouri than in some other parts of the country. The readjustment problems will therefore be more pressing here than in many other sections. I am sure that in this, as in other matters, you Missourians will "show" the country how to do it.

* President, Edison Electric Institute

STORAGE BATTERY EMERGENCY LIGHTING AND POWER PLANTS

(Continued from Page 83)

per cell. Obviously, the voltage is practically constant and throughout the discharge, remains within very narrow limits.

The installation and maintenance requirements of these batteries are very simple. The battery is received fully assembled and charged and maintenance consists of a periodical hydrometer test and terminal inspection.

The value of these low discharge batteries for isolated service are readily apparent. They are applicable to any kind of emergency light unit not equipped with a charger or which cannot, conveniently, be connected to another source of power. Figs. 7 and 8 show two types of portable emergency lamps made by the Carpenter Manufacturing Co. of Cambridge, Mass., using these low discharge batteries.

Typical Uses of Storage Batteries

While in most cases storage batteries installed in power stations are classified as emergency equipment, there are many cases where the battery floats on the line controlling circuit breakers, regulators and other essential equipment, such as electrically operated steam and water valves, combustion controls, gear-oil pumps and oil transfer pumps.

In steel mills, failure of control power may easily prove more serious than an interruption to the main power supply. Genuine protection against such failure demands an unfailing source of power such as a storage battery can provide and to that end batteries are installed in many of the country's largest steel plants. Similar conditions hold in paper mills.

Applications such as these are normal in peacetime but now that we are at war they become even more imperative. The one great essential in these times is to keep production going and the emergency storage battery is one device that can contribute materially in insuring against failure of production.

As in the case of nearly all essential types of equipment it may be difficult to obtain new storage battery installations but there are probably many batteries in service for purely emergency lighting purposes which could be made to serve other functions as well.

The PRACTICAL ENGINEER *and* ELECTRICIAN

RICHARD H. MORRIS, EDITOR

TIMES DO CHANGE

"Engineers?", queried Mr. Eminent Bigshot not so many years ago, "we use scads of them just as we use barrels of bolts, rivets and screws. We get the best and have our pick at a dime a dozen. Nice fellows but self centered introverts —too interested in their work—lack vision in the broad economic principles and aspects of modern business. We need men who can escape details and view the whole panorama—men who can deal with intangibles—not just make things."

A brief flurry of indignant criticism and the world settled back to await Mr. Hitler who takes care of the broad panorametric viewing himself and has taught the world that the men who make things are the only ones that count. The scene changes to one of the numerous agencies scouting for talent to win the Battle of Production.

"Dependents? Oh! yes . . . and over draft age? . . . good . . . There are a few openings for specialists of course . . . very few . . . you realize, of course, this is a young man's war . . . young men without family responsibilities . . . Thoughtful of you to want to do your bit . . . eventually will find a place for you no doubt if you will leave your name and address.

"What's that? Did you say Engineer? Miss Upson, call General Tank, Major Flight, Admiral Battlewagon and Captain Underwater—tell them we have an engineer! Make appointments a half hour apart—Mr. Peddle, take these appointment slips and pilot Mr. Engineer around until he sees them all. Sorry, Mr. E., for being so brusk earlier, but you see we have a steady stream of business men and executives with general training who can't DO anything specific. If you're an engineer we know you can do something and we will try to roll you along until you finally click into place."

From a "dime a dozen" to the "salt of the earth"—truly it's a long lane that has no turning.

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A Section of Power Plant Engineering Devoted to
PLANT OPERATION AND MAINTENANCE

Technical Publishing Company
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An Air Raid Warden Learns — THE HARD WAY

How a hospital engineer, responsible for, yet puzzled by, this unfamiliar blackout problem, set out to determine for himself just what could be done, what was practical and what impractical. His first report to the A.R.P. Advisor to the State Council for Defense brought the reply "I am taking the liberty of having your letter reprinted and distributed to other hospitals in the state as I consider you have met many of the problems that are common to such institutions." There is a great deal of current practical value in his experiences and, equally important, a forceful reminder that money is no substitute for common sense and ingenuity. Cost of window blackout—about 2¼ ct. per sq. ft. if you are very frugal

By ARTHUR H. PARKER
Peterborough Hospital
Peterborough, N. H.

IT HAS BEEN my good fortune, as well as my duty as an engineer, to attend Air Raid Warden Schools conducted in Concord and later in Peterborough, where I learned a great deal. In common with some hundreds of other newly appointed wardens, I have labored to impart this information to others and, in common with these hundreds of wardens, frequently find myself at an impasse—at a point where general information ceases to be adequate and "qualifications" have to be made.

It is impossible to give a reasonable degree of satisfaction unless I can provide definite information for it is not enough to tell what you think. Having had this experience, this realization of inadequacy, I determined to find out for myself, at the hospital, just what could be done, what was practical or impractical, and pass on this data to any person or organization who would be glad to avail themselves of accurate and detailed information about something actually accomplished.

It may well be that every engineer in charge of an institution is coping with these new problems in a manner entirely satisfactory to himself and others, and I may read, in some future issue of PE&E, solutions infinitely better and more practical than any I am about to describe. There may, however, be some who, puzzled and handicapped as I am with little time and less money, will be glad to know what can be done with the time and money available.

The Blackout at Peterborough Hospital

There are more than 150 windows, glassed doors, and side lights at the hospital and the task of blacking out all of these areas of glass is Herculean. The greatest area of glass is the big operating room window, 12 ft. 6 in. by 8 ft. 6 in. The smallest, the door side lights, 14 by 58 in.

It seems to me now, working alone and at the same time keeping up with other hospital maintenance, that the war may be over long before I get to the end of those interminable 150 windows, doors, etc.

As a start, I began with the skylights and ventilators. The kitchen skylight was in four triangular sections, topped with a tall, brightly painted ventilator. The skylight over the operating room suite is all in one plane and required a sheet of galvanized iron 8 ft. 6 in. by 5 ft. 6 in.

Galvanized iron, thinnest gauge, for both skylights, plus the work of cutting and assembling, cost $16.26, the biggest item of expense. I have wired these sheets to the skylight frames and painted them flat black. The ventilator was also painted black.

We were sent various samples of material to use for blackouts and finally decided that a building paper, sold under the trade name of "Sisalkraft" was the best for our purposes. This is very strong, almost impossible to tear, not at all expensive (1 ct. a sq. ft.) and best of all for the purpose is absolutely impervious to the passage of light. It can be obtained in a black or light colored sheet, the latter equally impervious, and its reflective quality "is a material and psychological asset" to those within.

My next job was to measure every square foot of glass in the hospital to find out how much paper and lumber were needed to build the type of frame I had in mind, a frame which could be suspended quickly from the upper part of the window frame, fastened at the side and about as fool proof as anything as yet tried or suggested. The actual cost (not counting time nor allowing for inevitable waste due to knotty and warped lumber, window sizes not conforming to width of sheet, etc.), to be roughly balanced between lumber and Kraft—a total of $51.17 breaking down into $25.14 for paper and $26.03 for lumber.

For framing I am using the cheapest available, hemlock about ⅞ by 1¾ in., costing 1 ct. a running foot. It does warp some, but kiln dried pine of at least 3 ct. a running foot is out of the question. The corners are mitred and fastened with ⅝ in. corrugated fasteners. The paper is tacked on with No. 4 tacks (straight, not staple) every 4 in. or so.

Up to the present I have made three different types of frame—two to hang from hooks and covering the full width and height of window frame, and, one to push in to the window opening, bearing against a light framing which must be nailed to the casing. The latter type is more expensive to make and more care must be taken in construction.

It is not possible to make the pushin type to exact dimensions, owing to future warping, etc., so they are made ⅛ in. smaller on a side. From a standpoint of practicability and taking into consideration the possible panicky condition of the staff member whose duty it may sometime become to put these frames up in a raid, the type which hangs from hooks is preferable for anyone who can hang up their hat should hang a blackout frame as easily and almost as quickly.

The actual breakdown cost of a 60 by 52 in. frame is as follows: Sisalkraft, 22 ct.; lumber, 19 ct.; corrugated fasteners, 2 ct.; hooks and tacks, 6 ct., giving a total of 49 ct. These prices may vary somewhat with locality. Our local lumber yard, however, sells us Kraft at prices quoted by dealers in bigger places.

The Heating System Causes Complications

The big operating, delivery, and emergency room windows were a problem. These are double windows, separated from each other (the two glass surfaces) by about a foot. Each window is steel framed, set into the brick wall as a complete unit. To drill this frame for suspension points would have taken a lot of time with my meager equipment, so I nailed the upper section of blackout frame permanently to the studding outside the metal window frame.

These windows presented another problem owing to the fact that the radiators are set behind the inner glass window and door surfaces, the flue between inner and outer glass surfaces forming a fine chimney for speeding up the circulation of heated air. It would be impossible to blank this off entirely and get any heat, or so I thought, so I made a separate panel for the lower part of the frame to be slipped up and in when needed. After the job was done, I found to my great relief, that enough heat was radiated from the heated surface of the paper to keep the rooms very comfortable.

When finished the operating and delivery room suite was discovered to show not a single light leak when tried out with all frames simultaneously.

There will probably be some future warping which will have to be corrected by tacking on a small piece of Kraft here and there, however, some of these frames had set around in the

heat for a week or 10 days before they were tried out all together.

The easiest and quickest frame to make rides on the stool cap or window sill with a strip of felting tacked to the edge of frame to make good contact. It hangs from the top by two hooks, and, two hooks at the side (one at each side) turned quarter way around to hold the frame securely to the window casing. It only takes a few seconds to hang one of these up.

I have had an interesting time with efforts to develop a blackout paint[1] or stain for lamps and shades but have met with more success than expected. Prussian Blue colors in oil mixed with turpentine in a proportion of one teaspoonful of blue to an ounce of turpentine makes a fine stain. It works fine on porcelain or glass and about as well on light shades. I do not use over 25 w. lamps as the stain prevents radiation to a certain extent and the globes become rather hot, not hotter than say a 100 w. lamp, but this higher temperature is a point to be taken into consideration.

In conclusion, I trust that my experience will be of some real help to other worried engineers and that perhaps we can exchange further experiences. As for myself I have the satisfaction of knowing that something tangible, something you can "get your teeth into" has been accomplished, effectively and within the resources available.

[1]One coat of good black paint should cut the light transmission about 95 per cent, and two coats are necessary to hide windows completely. It should also be remembered when painting skylights and windows subject to reflection, that the black paint on the inside makes a perfect mirror so that the paint, to be effective against bright moonlight or searchlights, should be applied on the outside. As noted by Mr. Parker black paint absorbs heat and for this reason may cause breakage when applied to large windows.

Why Not Use Whitewash?

By H. C. COLE

PRIORITY CONTROL over the available supplies of lead and zinc will sooner or later force the adoption of substitutes for these materials in many widely divergent fields. Of especial interest to the engineer will be the scarcity of lead and zinc base paints commonly used on many plant painting jobs.

Fortunately there are a number of paints having solid components made of materials not so essential as those mentioned, which, if properly selected and applied will ordinarily prove entirely satisfactory for most applications. Then too, there is always "whitewash."

In recent years whitewash as a protective and decorative agent has given way to more wearable and incidentally more expensive paints. There are however many specific applications for which whitewash is ideally suited. The swing away from this cheap and readily obtainable material is easily understandable, however for too frequently in the past haphazardly mixed whitewash has been indiscriminately applied.

As a consequence the job has been off color, rapid dusting and flaking off has been experienced and, where exposed to the weather, the coating has been washed off by the first heavy rain. All of these difficulties could have been avoided had the whitewash been properly compounded and mixed.

Numerous formulas for making whitewash are in existence. Two that have shown particularly wearable qualities are:

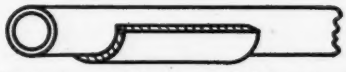
For exterior use: A, mix 80 lb. of hydrated (well slacked) lime with water until its consistency approximates that of heavy cream; B, dissolve 2 lb. of common salt and 1 lb. of zinc sulphate in 2 gal. of boiling water; and C, mix A and B and then add 2 gal. of skim milk.

For interior use: A, mix 80 lb. of hydrated lime with water until a creamy consistency is obtained; B, add 2.5 lb. of rye flour to ½ gal. of cold water and mix thoroughly. Dilute with 2.5 gal. of boiling water; C, dissolve 2.5 lb. of common salt in 2.5 gal. of hot water; and D, stir together B and C and then add A. Stir until thoroughly mixed.

Addition of other ingredients will make a substantial improvement in the quality of whitewash. A little alum will toughen the film and prevent rubbing off. One pound of cheap bar soap dissolved in 1 gal. of boiling water will, when mixed with 5 gal. of whitewash, give a glossy finish to its surface. Addition of a pint of molasses to 5 gal. of whitewash improves its penetrating value when it is applied to wood and plaster.

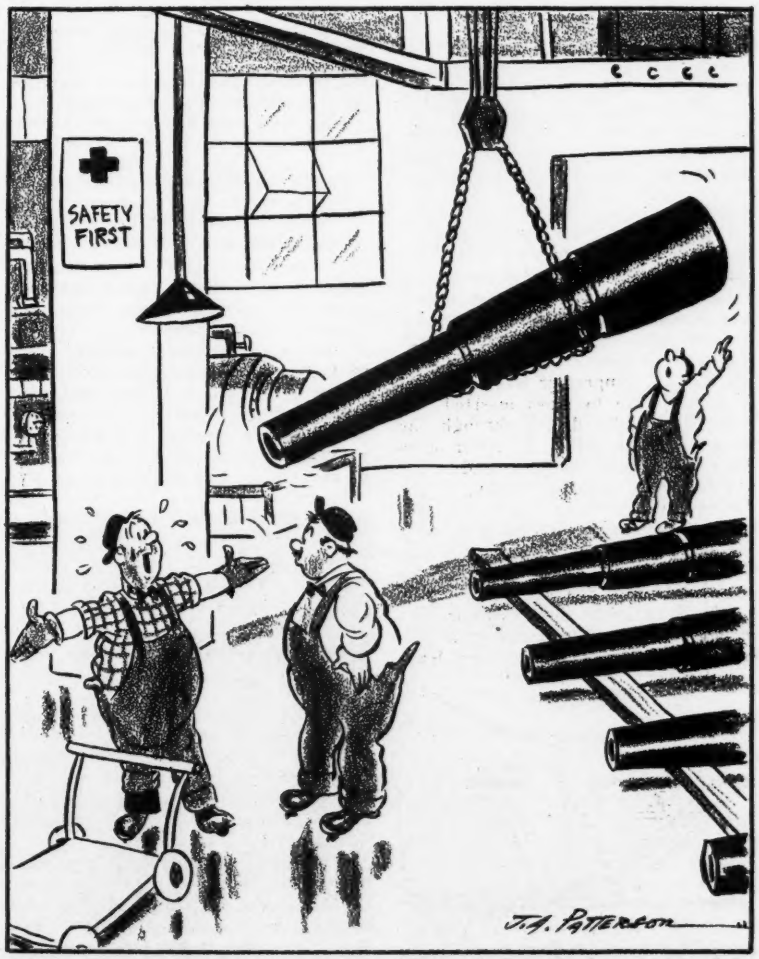
Pipe Half Soles

PIPE corroded or eroded by moisture, electrolysis or abrasion, usually occurs on the bottom of the pipe, and can be reclaimed by welding half soles or patches of new steel plate. Lincoln Electric who supplied the drawing rec-



Half sole welded on corroded section of pipe prolongs its useful life

ommends two passes of Fleetweld electrode all around the patch and reports repairs of this kind made with the line operating under pressure. Small pits can be built up by the electrode alone without the use of patches.



"Oh, yeah, well I never was nervous and jittery before the company took on these defense orders"!

CONSTRUCTION AND REPAIR

Repairing Leaks in Concrete Reservoirs

By S. H. COLEMAN

SOMETIME after completion of a 1,000,000 gal. reservoir in the service water system of a large Southern manufacturing establishment, it became evident that a great quantity of water was being lost through leakage. Located in a bowl shaped excavation on top of a high hill overlooking the plant, this reservoir is of conventional sectional concrete construction, with individual slabs separated by redwood joints, designed to compensate for expansion and contraction of the masonry.

While no visible sign of leakage was apparent in the immediate vicinity, increased demands on the pumps indicated prohibitive losses. A 24 hr. test, with the reservoir shutoff valve closed, showed a marked drop in water storage and water was found bubbling up out of a formerly dry limestone outcropping some distance away. Analysis of water in the reservoir and at this point definitely confirmed the source.

Some Detective Work Was Necessary

Finding out how the water was getting through the concrete lining presented a complex problem and it was finally decided to pump air under the concrete so that points of leakage would be indicated by bubbles. A portable air compressor was connected to an air hose to pipes inserted and sealed into holes drilled through the lining as shown in Fig. 1. After operating the compressor for several hours, bubbles were observed coming to the surface at numerous points. Closer observation, using a glass bottom bucket to facilitate vision, indicated that in every instance the bubbles originated along the expansion joints.

Upon draining the reservoir and cutting the concrete away from the expansion members at the worst leakage points, it was discovered that the concrete was porous. Apparently too stiff a mix had been used, and the wet material had not been properly puddled around the joints.

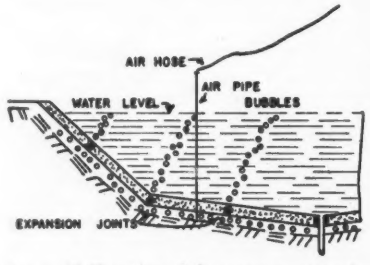


Fig. 1. Half section of the concrete reservoir showing how compressed air was used to indicate the points of leakage

In order to overcome this trouble and at the same time avoid interfering with expansion compensation at the joints, 2 in. of redwood was removed from the top of the strips, using chisels and chipping tools. After removal of the wood a special asphaltic sealing compound intended for this particular use was forced into the joints between the remainder of the redwood strips and the concrete with high pressure calking guns.

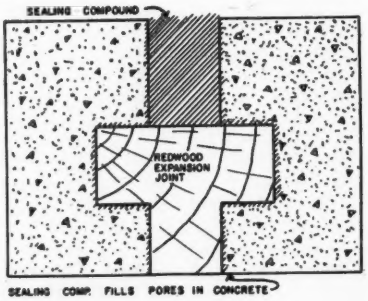


Fig. 2. Detail of the redwood expansion joints. The top of the wood was chipped out and the space filled with an asphalt sealing compound to stop the leakage

Before use the compound was heated to decrease its viscosity to a point where it would flow without difficulty into all air spaces in the concrete adjacent to the wood. Following this sealing, the trenches left by the removal of the upper sections of the redwood strips were filled with hot compound, until flush with the surface of the concrete. This treatment effectively stopped all leakage from the reservoir and made a substantial saving in pumping power requirements.

Heating Control Saves 16 Per Cent

WHILE browsing around the new filtration plant in Milwaukee, Wis., recently, John E. Hubel was intrigued by the dial controls on the radiators. "Something," he says, "like the knobs on the older radio sets but graduated in degrees F. up to 85."

"Thermotrols," explained the engineer. "You set the knob and the radiator remains at the temperature setting until the knob is moved again." "Savings?" says Mr. Hubel with a nose for news and his eye on a dollar to buy Defense stamps. "Plenty," says the engineer, but here he fell down—opinions are one thing, substantiating data another.

However, the day was partially saved; the engineer did have a detailed report of savings made in an installation in Minneapolis collected while purchase of the controls for the filtration plant was under consideration.

This data for the Pere Marquette Bldg. in Minneapolis is shown by the table. The controls installed cost $1550 and the steam saving is calculated as $601 per yr. In pounds per degree day the savings were 547 — 459 or 88 lb. 88 ÷ 547 equals 16.1 per cent savings, which on a steam cost of $3736.63 is equal to $601.

Steam used before and after installing temperature controls in the Pere Marquette Building in Minneapolis

After Control Installation	Deg. Days	Lb. of Steam	Cost of Steam
1936 February	1886	762,300	$ 640.41
March	1087	535,000	449.49
April	753	414,000	339.48
May	111	100,100	81.08
September	92	58,300	47.28
October	579	282,800	254.70
November	1044	457,200	420.53
December	1316	614,600	565.43
1937 January	1847	759,100	705.96
Total	8715	3,983,400	$3,499.36

Steam consumption with controls—459 lb. per deg. day.

Before Control Installation	Deg. Days	Lb. of Steam	Cost of Steam
1935 February	1106	581,400	$ 546.61
March	961	553,000	459.07
April	630	405,200	340.36
May	313	226,300	192.44
1934 September	234	181,200	148.59
October	341	285,400	251.16
November	786	475,100	408.59
December	1550	705,000	662.70
1935 January	1674	749,700	727.11
Total	7595	4,162,300	$3,736.63

Steam consumption with controls—547 lb. per deg. day.

During the period under consideration the building occupancy increased from 70 to 100 per cent which increased the steam load and decreased the steam savings proportionately. That is the savings as calculated on a degree basis makes no allowance for the increased occupancy.

Crow Foot Anchor Bolts Stay Put

By B. H. WHITEHOUSE
Engineman-in-Charge
Milwaukee County House of Correction
Milwaukee, Wis.

ANCHOR BOLTS come in for more or less discussion usually in connection with new equipment, even though manufacturers of most apparatus will gladly furnish detailed information for their equipment. Just how to proceed in a case where improper work has been done, and without creating too much expense, however, is not always so easy.

Therefore, the method followed in one such instance is offered for those who may be confronted with a similar problem. This was in connection with a two stage steam driven air compressor. Anchorage was originally accomplished

by placing 5/8 in. machine bolts in the concrete and extending them up through the frame as shown in Fig. 1. From repeated tightening, in time these pulled up through the cement and became useless. Figure 2 shows the method of repair.

The cement was broken out from under the base and holes drilled into the foundation a sufficient depth to secure adequate holding power. Then round mild steel was cut of the proper length to extend out of the hole 6 or 8 in.

Molten Sulphur Does the Trick

A piece of mild steel was then cut the proper size to fit the hole in the machine frame, and a thread cut on one end to hold a nut and washer. This bolt was placed in the hole and the projecting ends of the others heated with an acetylene torch, twisted around the foundation bolt and all welded together. The lost motion was taken by tightening the nut a little and molten sulphur from a babbit ladle poured into the space around the rods in the foundation. This is all shown quite clearly in Fig. 2. The cement was patched up and the operation was finished. This particular bolt has been in service for over 8 yr. and shows no sign of weakening.

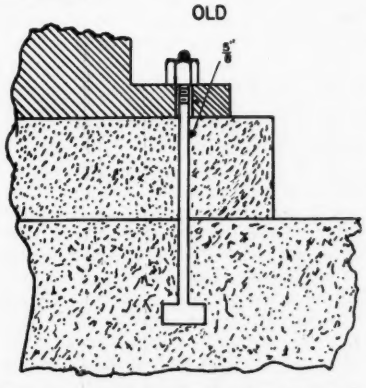


Fig. 1. Construction of the original foundation bolt which pulled out

When pouring molten sulphur it is advisable to have a helper stand behind the operator with an air hose to blow the fumes away as strong sulphur is very disagreeable to inhale. Dimensions of the iron and drills used were purposely omitted as this will have to be determined from the load to be carried in each case.

Editor's Note: In the course of editing this article, Mr. Whitehouse was asked why he preferred molten sulphur instead of cement, grout or lead. His reply is self explanatory:

"There are other materials that could be and are used for this purpose. However, I have found that cement grout in thin layers as in this case will crack and loosen, or, where oil saturated it will soften and deteriorate. Lead will shrink and cannot be caulked to such a depth. Leadite hardens real hard and is very good, but the cost is much more than sulphur which will do a job equal in every way to Leadite. With lead, Leadite or surphur you do not have to wait for it to set as with cement. With Leadite and sulphur there is very little if any contraction upon setting after pouring."

"Leadite is a trade name used by The Leadite Co. of Philadelphia, Pa. It is composed of sulphur, lead and other ingredients; has a lower fusing point than lead; sets harder and

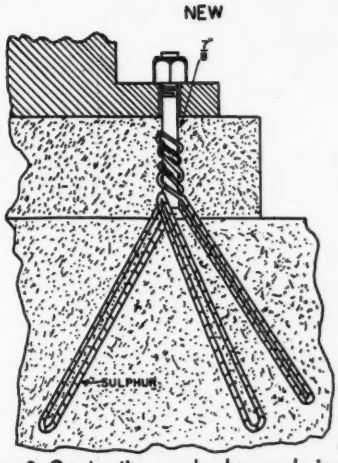


Fig. 2. Construction used when replacing the bolt. The separate rods were twisted around the short bolt and welded before the concrete was replaced

resembles, when set, dirty dark glass. Before melting it has the appearance of gun powder. It cannot be caulked as lead can, it is higher in price than lead but much more bulky. Some contend that when used on a pipe line (cast iron) under a roadway that the mechanical shock of heavy traffic will not cause leaks which are experienced with lead joints. Small leaks caused by faulty pouring such as pin holes or some that may develop from mechanical shock will in a short period seal themselves.

"As a comparison of cost, the price of Leadite in Milwaukee last year was $10.75 per 100 lb. compared to lead at $6.45. However, a 4 in. C.I. water pipe joint requires only 2 lb. of Leadite but 7.5 lb. of lead, giving a joint cost for Leadite 20.5 ct. and 48.375 ct. for lead. Then labor for caulking must be added to the lead joint."

Single Shot Oiling Cures Stoker Trouble

By JESSE F. CLACK

RECENTLY a hydraulic ram type underfeed stoker developed serious trouble from the sticking of the coal piston. Despite the fact that the piston was always left in the forward position during standby periods to prevent burn-back into the hopper, the trouble became more frequent. Upon dismantling it was necessary to use a jack to remove the coal piston and the outside was covered by an accumulation of carbon similar to that found on the head of an automobile cylinder.

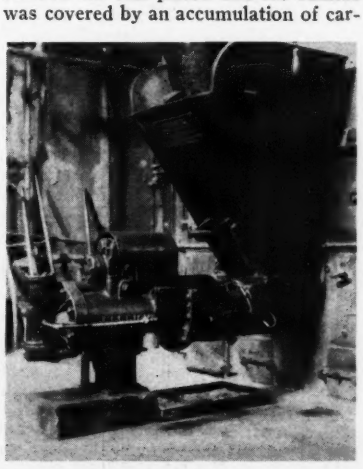


Fig. 1. Six single shot oil fittings stopped sticking of this stoker ram. The oil holes are at about mid-length of the piston at its extreme outward travel

This piston, approximately a foot in length, was cleaned and replaced. Its position when in the extreme backward position was noted, and it was then moved to full forward position so as to be out of the way. A circumferential line was then drawn around the outside of the coal cylinder at a point opposite the mid-length center of the coal piston, in the full backward position.

This line or circumference was then divided into six equally spaced divisions, into each of which a hole was drilled, and tapped, to take a 1/8 in. pipe thread. Into each hole was screwed a small fitting with a very small spring type ball check valve—part of a Bowen "Single Shot" system of lubrication. The six were fed in parallel from a small line.

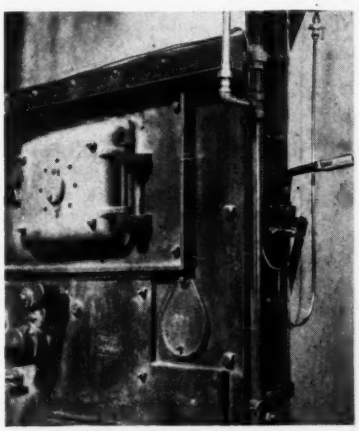


Fig. 2. Oil pump used. The pipe on the right comes from a 1 gal. oil tank, the one on the left leads over the warm front of the boiler to the stoker

Figure 1 shows the arrangement around the outside of the coal piston and Fig. 2 the small pressure pump that can exert a pressure of 500 psi. The larger copper tube leads from bottom of tank of about 1 gal. capacity, the smaller line leads to the fittings on coal piston. A cheap thick black oil is used as the need is not so much for lubrication as for a solvent or softener. Upon being forced out between piston and cylinder wall the oil spreads over surface of the cylinder and piston. This softens the carbon deposits and they are wiped off by the backward and forward motion of the piston.

When burning cheap or dirty coal, a thin oil is readily absorbed by the dust and dirt, and will not operate as satisfactorily as the heavy oil.

In Figure 2 it will be noticed that the oil line runs along the angle iron over fire door. This tends to keep it warm in the cold weather. If possible avoid long lines, and those exposed to cold and drafts.

This installation has been in service about 3½ yr., and the first repair has yet to be made. The cost of material at that time was approximately $25.

COMPRESSORS AND PUMPS

A Good Use for Old Refrigerators

By ALLAN KNOX

MOST PLANTS at some time or other have need for a small, portable air compressor useful for spray painting and similar jobs. Due to the cost, however, many small plants are obliged to forego this luxury. When our maintenance crew was faced with a similar problem of obtaining a paint sprayer with a minimum of expense, the engineer made an excursion to the shop of a nearby refrigeration service company where he obtained for, the modest sum of $10, an ancient two cylinder Frigidair refrigerator unit complete with motor, frame and condenser. Pistons were frozen in the cylinders, and the valve seats needed regrinding badly, but the cams, shaft and seal were still in fair condition. With the expenditure of plenty of elbow grease to dislodge the pistons and considerable scraping and cleaning, and the expenditure of another $2 for reed valves, piston rings and head gasket, we put both motor and compressor in serviceable condition. The condenser was sold for junk, but the receiver was pressed into service as an air storage tank.

The unit was originally supplied with a weight operated high and low pressure cutout to control the temperature of the connected evaporating unit. We discarded the low-pressure portion of the control switch, but kept the high pressure bellows which we connected by means of levers to the motor switch. We inserted this assembly in the air line in such a way that if excessive pressure should develop anywhere in the unit, the high-pressure control would go into operation to cut off the motor and so act as a safety device.

After putting the compressor into operation, we found that, besides pumping some oil, the unit had a tendency to squeeze water out of the air that it compressed, so we were obliged to improvise an air filter and drier. This was made from 2-in. brass tubing about 10 in. long, sealed at each end with a soldered cap. The top cap was provided with two ¼-in. flare tubing connections, while the bottom cap was supplied with a small drain cock. The body of the filter was divided into two connecting chambers, the upper one filled with discs of felt, the lower left empty.

The inlet connection extended down to the top of the bottom chamber where drops of oil and water could accumulate and be removed through the drain cock. The outlet connection was placed at the top of the upper chamber. Oil and moisture laden air was then passed first into the lower chamber where most of the liquid condensed out and any remaining vapor was absorbed by the layers of felt as the air passed up through the top chamber and thence into the air line.

Two pairs of casters mounted on the underside of the compressor frame made the entire unit readily portable. This reconditioned refrigerator is capable of supplying at a pressure of 50 lb. a steady flow of air sufficient for a standard size spray gun of 1 qt. capacity.

Noiseless and Bombproof Booster Pumps

IN BUSINESS districts nuisance noises of surface type water supply pumps and motors may lead to legal action and a recent installation of the Investment Water Corp. of Los Angeles, Cal., solves this problem very neatly. This installation, designed by Clyde L. Mowder, chief engineer, is shown by the accompanying drawing.

The pumping unit consists of a 100-hp. Byron Jackson Submersible motor and 12 in. diam. 6-stage bowl pump assembly located at the bottom of 200 ft. of 8-in. standard pipe column in a 16-in. diam. well. The unit serves both as a well pump and a booster unit, delivering 800 g.p.m. of water against a total head of 340 ft. into a reservoir; 160 ft. is lift to the surface and 180 ft. is the head above the collar of the well.

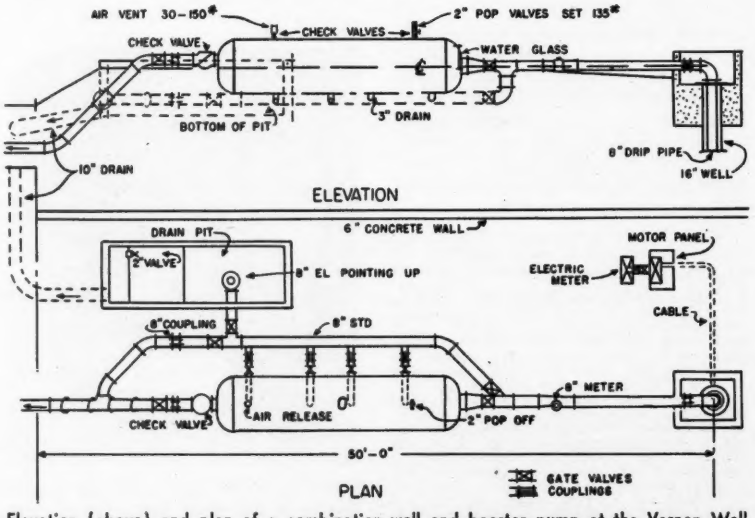
After leaving the well surface elbow, the water passes through an 8-in. Neptune meter and thence to the 4 by 16 ft. A.S.M.E. Code steel tank, serving as an air cushion and a sand trap. The 8-in. tilting disc Chapman check valve has been found to operate very successfully in connection with a special column check valve in the well, just above the pump bowls.

Inasmuch as the well is new, this latter check valve is used to prevent the water column running back into the well and tending to cause sand troubles. Some sand is being pumped and this is effectively eliminated by the surface sand trap, which is provided with a drain line.

Routine pumping at present includes complete draining of the sand trap each day, with air at atmospheric pressure admitted through the 2-in. check valve. The pump is started with the tank serving as an air cushion, but all of the air is eliminated in a comparatively short period through the air release valve, which automatically closes when the tank is full of water.

For various reasons it is desirable that air shall not be delivered into the distribution system, therefore, the tank is so designed that the air at atmospheric pressure is compressed to an elevation just above the discharge line when the pressure reaches 78 lb. required to open the check valve and deliver water into the system.

The drain line is provided with suitable gate valves so the sand trap tank can be completely bypassed if any emergency should necessitate this procedure. A Byron Jackson depth gage is mounted at the bottom of the panel (outdoor type motor starting) and connected to the well through copper tubing. This gage is constructed with a movable dial which is adjusted to the known length of the detector or air line in the well to indicate the distance to the water level.



Elevation (above) and plan of a combination well and booster pump at the Vernon Well pumping plant complete with cushion tank, sand trap, drain pit and bypass piping

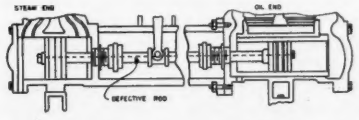
Since the war started, bringing with it the danger of damage from air raids, installations of this type take on added importance. Surface installations are vulnerable to both bombs and saboteurs and locating conventional pumping units underground is expensive and not always practical due to the danger of a gas explosion, flooding from broken lines, air circulation and ventilation, etc. In the installation described, the pump and meter could not be damaged by bombs and surface damage to piping, valves and fittings could be quickly repaired.

Incredible? Well Acid Is Acid

By CARL EGERTER

SEVERAL YEARS ago an American freighter, which plied between New York and French ports, had three oil-fired, Scotch marine boilers. The fuel was pumped to the burners under a pressure of 80 lb. by a duplex type steam pump. Condensate was returned to the hotwell.

One day when the boat was on its way to New York, the fireman reported the collapse of the crown sheet and the bulging of the shell on one of the boilers. Provision was made for the removal of the lubricating oil in the pump exhaust, but for some unexplainable reason the fuel got into the feedwater.



Acid ate a hole the entire length of this pump piston rod and the contaminated condensate ruined a boiler

Subsequent investigation by boiler inspectors and photographic evidence proved, incredible as it may seem, that one piston rod of the fuel pump had acid holes, the full length of the rod as indicated by the sketch. These holes made an unbroken passage for leakage of oil to the steam end of the pump and the oil and condensate mingled freely.

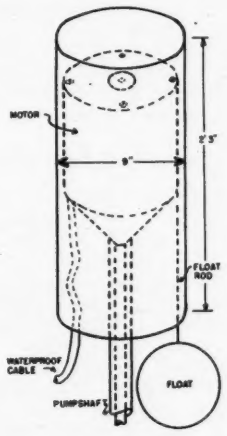
As a consequence of the discovery of the acid holes, the engine room force was absolved of any blame.

Safeguarding a Bilge Pump

By P. C. ZIEMKE

IN OUR PLANT we have a service tunnel that leaks water through sides and floor during periods of heavy rains. A 4 by 4 ft. sump at one end of the incline drains this water off and a ½-hp. repulsion-induction motor powered vertical bilge pump keeps this pit dry. However, during a midnight electrical storm when a deluge of rain flooded gutters and down spouts the half hour of power outage allowed the sump to fill and drown the idle motor.

Later when service was restored the wet motor burned out since the night engineer had his hands full attending to other duties. Some hours later when he switched the light on to inspect the wheel pit under the synchronous motor driving the air compressor, he discovered water dangerously near. He averted a shutdown by hastily setting up a small centrifugal pump.



This inverted can keeps the motor dry even when water is 18 in. over the top

After toying with several ideas on how best to prevent a second occurence we hit on the solution by enclosing the bilge pumps motor in a watertight cover. No. 20 gage sheet metal was cut on the power shears to form a tube and an end. Arc welding served to make this a water tight cylinder 9 in. in diameter and 2 ft. 3 in. long which was inverted and pushed down over the motor and bolted in place to prevent it's floating off in times of high water. Now, as experiments have proven, the air confined in the cylinder keeps the motor dry although submerged by 18 in. of water, at which point the water flows into the city sewer.

Foot Valve for Oil Pump Suction

By GEORGE L. RADAMAKER

IN OUR induced draft fans, used in a waste heat boiler, conditions are such that at one moment the fan and turbine may be rotating at maximum velocity and the next moment may be stopped dead. One of the chief operating troubles with this equipment was in supplying sufficient oil to the reduction gear and reduction gear bearings. Oil rings were not satisfactory and a gear oil pump lost its suction frequently when the fan stopped.

Since the rotary oil pump was driven directly from the reduction gear shaft the oil reservoir was necessarily below the rotary oil pump. Since there was no way to correct the conditions of operation of the fan some method had to be devised to prevent the oil pump from losing its suction.

A foot valve of the ball check type was installed below the surface of the oil in the reservoir, thus maintaining a prime in the suction line to the oil pump. Since this has been installed we have had no further trouble.

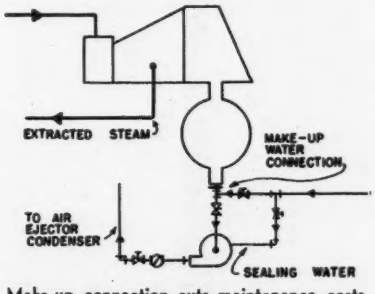
Make-up Connection Cuts Pump Maintenance

By H. C. COLE

CONDENSATE pumps serving the condensers of extraction type turbines supplying steam to industrial processes are subject to service conditions much more severe than those imposed on comparable pumps used in central station practice. Perhaps the most destructive of these conditions is a deficiency of condensate handled by the pump. This deficiency is present not only when starting up the turbine unit, but frequently for long periods of time when operating requirements are such that most of the low-pressure steam, available at the extraction nozzle, or nozzles, is utilized.

Although with full extraction, turbine designers necessarily allow a small volume of cooling steam to enter the low-pressure blading between the extraction valve and the condenser, this quantity is seldom more than 5 to 10 per cent of the condensate pump capacity. In effect, then, the pump must operate as if its suction valve were throttled. It is thus likely to suffer some of the ills attendant upon this method of operation, namely, excessive wear due to unbalance and cavitation.

Maintenance required by condensate pumps used in this class of service can be materially lowered by providing a means of injecting part of the make-up water required by the plant into the condenser hotwell connection as shown in the piping diagram. Since make-up water is commonly used to seal the pump shaft packing glands, installing the necessary connection is ordinarily a relatively simple matter. Such an auxiliary water supply to be completely effective requires manual control of its injection, together with the throttling of the condensate pump discharge valve to a degree commensurate with the load curve.



Make-up connection cuts maintenance costs on hotwell pumps in industrial plants

Not only will such an auxiliary water supply protect the pump and increase its reliability, but where jet type vacuum pumps having inter and after condensers cooled by condensate are installed, the added water will prevent loss of efficiency when the main unit condenser is operating at an extremely light or minimum load. The foregoing advantages more than compensate for the slight increase in condensate pump power.

HINTS AND KINKS

How to Attach Letters to a Stack

By LESLIE BRADLEY

AT TIMES it is desirable to place letters or a name on a chimney or smoke stack. As chimneys are made of different materials, cement, brick, steel, the same method cannot always be used. With a brick stack different color brick can be used. If the stack is of steel, or cement, the lettering cannot be painted directly on the stack, for the paint will soon be illegible, due to smoke, dirt and soot. Also, with unlined steel stacks, the heat will in most cases cause the paint to peal off at least in spots.

We had these facts in mind when our management wished to have a sign put up on our stack. Therefore, we cut a set of letters from tin sheets and then set out some distance from the stack by means of rods. Experience over 2 yr. has proven that the letters keep clean and attractive, even those within a few inches of the top of the stack.

The letters themselves are made from 26 gage tin sheets and are 28 in. high by 45 in. wide. Each letter is held out from stack by a number of pins made of three-eighths in. rod 2¾ in. long. One end was cut to ¼ in. diam. to form a shoulder for riveting to the letters. The other end was then welded to the stack by arc-welding. On a cement chimney these pins could be set in the cement.

To weld the letters to the stack brought up the question of a safe, low cost scaffold to do the job. To do this the carriage shown in Fig. 2 was made. It proved very successful and can now be used for any other repair work or painting on the chimney. The carriage is shown in detail and can be made from scrap material found around most any plant. The only precaution that needs to be taken is to be sure that the wheels are well below the level of the seat. From 12 to 15 in. will be sufficient to prevent the seat from tilting backwards when the operator sits in it.

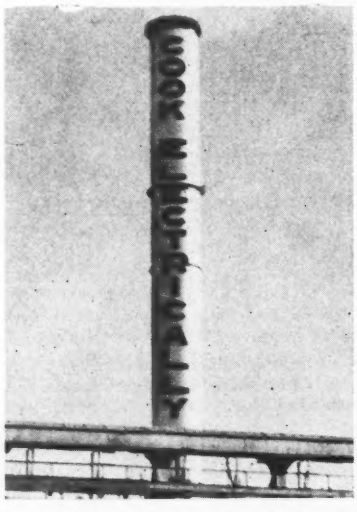


Fig 1. These letters cut from sheet metal are supported about 2½ in. from the stack by welded on rods

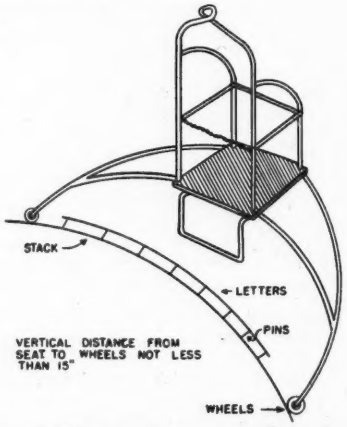


Fig. 2. This cross between a sulky and a boatswain's chair will be found handy for painting, repairing or inspecting stacks. It was built from scrap to put up the letters shown by Fig. 1

Safe Rope Slings

By P. C. ZIEMKE

SEVERAL FATAL and near fatal accidents that occurred in local plants indicate the need for closer attention to plant maintenance especially of cables and slings used on crane service. Maintenance men should all be familiar with loads, slings, cables and safe working stresses.

We do not arrive at the solution of the problem by merely glibly stating the "safe" working load of a wire rope since that varies with the numerous types of service wire rope is called upon to perform. Obviously not all types of service require the same factor of safety. Steel in the form of wire rope will withstand variable stresses for an indefinite length of time provided that these stresses are kept below a certain value known as the endurance limit. When subjected to stresses above that point steel will deteriorate rapidly.

Factors of safety in excess of five, varying up to eight and perhaps ten, are required for safe and economical operation. This means that the factor of safety should never be less than five. The proper working load is readily determined by dividing the breaking strength by the factor of safety: for instance a 6x19 crane cable of ⅞ in. plow steel will have a breaking point of 28 t. and with the safety factor of five the working load will be 5.6 t.

Some plant managers appear to be sold on the use of cordage for slings for reasons better known to themselves, however, this article will concern itself with only the steel cable sling in use in the majority of the plants. As a rule wire-rope slings are composed of two single slings or legs fastened together at the top with a ring or link which is thrown over the crane hook.

Legs of this sling assume various angles in keeping with the shape of the load as is indicated in the diagrams in the table of safe working loads.

Safe hoisting depends on a fine of judgment in sizing up a load and quickly determining the proper size sling and manner of hitch to use. It is important to remember that changing of angles in the legs of the sling greatly affect its capacity. For instance, a 1 in. sling at an angle of 60 deg. (Column 7) should lift only 20,800 lb., and, at 30 deg. this safe limit is reduced to 12,000 lb. (Column 3). Yet the same pair of 1 in. slings used on the ordinary vertical lift has a capacity of 24,000 lb. as indicated in Column 6.

How to Build a Drill Press

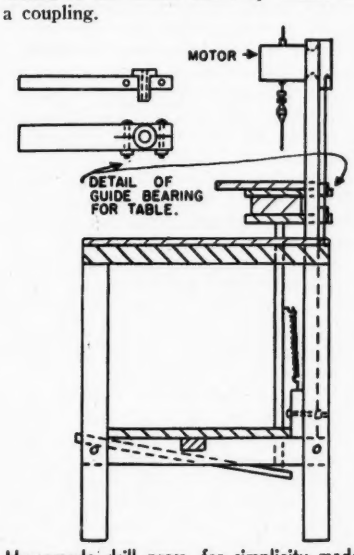
By V. W. PALEN

PERHAPS you too would like to buy a drill press but just can't scrape up the price of one. That was my predicament so I decided to build one. A table was built out of two by four's with two up-

Table of safe working loads for 6x9 wire rope slings with spliced-in fittings, or rings and hooks fastened with clips, which do not bend around the lead. Figures based on a factor of safety of seven and the breaking strength indicated in the second column

Rope Diam. In.	Rope Breaking Strength Lb.	Vertical Hitch	Anchor Hitch	Basket Hitch	Double Vertical Hitch	Double 60 deg. Hitch	Double 45 deg. Hitch	Double 30 deg. Hitch
⅜	12,600	1,800	1,500	3,000	3,600	3,100	2,500	1,800
½	21,600	3,100	2,500	5,000	6,200	5,400	4,400	3,100
⅝	33,200	4,250	3,500	7,320	8,500	7,400	6,000	4,250
¾	47,400	6,800	5,600	11,800	13,600	11,800	9,600	6,800
⅞	64,400	9,200	7,600	16,000	18,400	15,900	13,000	9,200
1	84,000	12,000	9,900	20,800	24,000	20,800	16,900	12,000
1⅛	106,000	15,100	12,500	26,400	30,200	26,200	21,400	15,100
1¼	130,300	17,500	14,500	30,800	35,000	30,400	24,700	17,500
1⅜	157,000	21,200	17,500	37,200	42,400	36,700	30,000	21,200
1½	185,000	25,200	20,800	44,200	50,400	43,600	35,600	25,200

rights, extending through the main table top at the rear. These carry a crosspiece on which the motor is securely bolted. The motor is vertical, with a chuck attached to the motor shaft by means of a coupling.



Homemade drill press, for simplicity made with the drill stationary and the table movable

The chuck and coupling can be purchased from a mail order house for about 75 ct. and a ¼-hp. motor can usually be found around any work shop. Otherwise a second hand washing machine motor can be purchased for about $3.00.

On a conventional drill press the chuck moves up and down. On my drill press the chuck is stationary and the table moves up and down. As shown on the drawing two model T Ford brass shackle bearings (8 ct. a piece at mail order or auto supply houses) are mounted by means of wood pieces to the under side of the movable table top. A 24 in. length of ½ in. shafting (25 ct.) is installed vertically and on this the bearings of the movable table move up and down.

On a two by four fastened to the table legs, about a foot above the floor, a large hinge is fastened. A board attached to the hinge serves as a foot pedal and transfers the force to a vertical hardwood member whose upper end is fastened to the underside of the movable table by means of a nail pointed at both ends and driven into place.

This vertical piece travels in square openings in the lower shelf and in the main table top. So that lumber, piled on the undershelf, will not interfere with its operation a wooden enclosure can be built around the vertical hardwood sliding piece. A piece of screen door spring pulls the movable table to the lowest position when pressure is removed from the foot pedal.

No dimensions are given on the drawing since each individual will no doubt wish to use his own descretion in this regard. My model has an up and down movement of 5 in. which is sufficient since most twist drills are about that long.

The foot pedal supplies plenty of pressure when needed and leaves the hands entirely free to guide the work. Not shown on the drawing is an electric socket soldered to a piece of copper tubing bent into a "J" shape. This is fastened to the top timber alongside the motor supplying light for the work. The writer also fastened his emery wheel (with the shaft vertical) to the assembly. By removing the chuck and replacing it with a pulley on the motor shaft the motor can be made to perform double duty.

Double Foot Trouble

To ARRIVE at any definite remedy, it is first necessary to arrive at a cause and if accidents are to be eliminated it is first necessary to know why and how they occur.

In the manufacture and distribution of ice, for instance, most of the serious accidents occur in the plant. Many of those can be directly traced to either poor housekeeping or improperly or unguarded machinery. This is quite generally true in any industry in spite of the fact that manufacturers of machinery have, during the past several years, done a most remarkable job of guarding exposed parts of new machinery.

One of the prime causes of high workmen's compensation insurance rates in an ice plant is the old ice scorer with its exposed saws. Those instruments tore off more hands, arms, feet and legs then the Medieval rack ever did.

One accident on file by the N.S.C. is of special interest. One morning an employe was placed at work on the dock, scoring ice. A block became wedged and he attempted to shove it with his foot. He went too far and cut off a foot.

He was hurried to the hospital and the foreman undertook to handle the rush of business. A cake became wedged, he shoved it with his foot with exactly the same results as his predecessor. Two injuries, with identical causes and results in 15 min. time.

Sam Beats Priorities Orders

By SAM WILLIAMS

WITH THE war production program in full swing, it is impossible to obtain machine tools and accessories so every engineer has to exercise his ingenuity to the utmost to kep his plant in shape with the equipment on hand.

When we needed a sanding, milling and boring table for a lathe we made our own. The sanding disc was constructed from half of a rigid coupling bolted to a discarded 8 in. blanking flange. The assembly was then fitted to the lathe spindle and turned true.

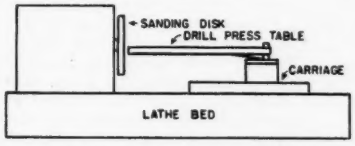


Fig. 1. Sander lathe attachment built from a discarded flange and a drill press table

As foundries are not willing to accept small casting orders, we obtained from a manufacturer a table from a bench model drill press, and, by means of a stub fitted this to the carriage and assembled the table on the lathe as shown by Fig. 1. This gives us an 8 in. disc and 7½ in. table at a cost for materials of $3.75.

It is often desirable to remove work from the lathe for drilling or filing

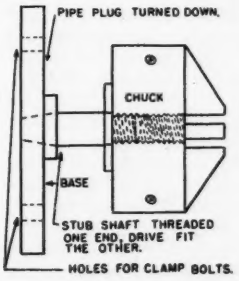


Fig. 2. This faceplate turned from an old pipe plug allows work to be removed from a lathe without disturbing the chuck setting

operations, and then return it to the lathe spindle without disturbing the original set-up. To handle this work with the least difficulty, we took a discarded 8 in. pipe plug, mounted it in a four jaw chuck, and bored it through the center for a stub shaft. With the same set-up we turned down the base of the plug and squared it with the bored hole.

A stub, threaded at one end to conform with the lathe spindle, and, with a drive fit in the bored hole in the plug, was next fitted to the plug. Now we can remove the work, chuck and all from the lathe, screw the chuck on the above outfit as shown by Fig. 2, and mount the whole thing on any of our other machine tools.

Incidentally, when strapping work to a face plate or table, use a wrench of the torque limiting type to help minimize distortion of the work.

THE ENGINEERS' PRIMER. III

Mac practically goes into the junk business to show how extraction improves cycle efficiency by reclaiming some of the condenser loss, but he does this only after Andy prods him into admitting that a logical development of the heat balance from first principles is a bad approach. "That method," says Mac, "is dry as dust. At our plant we believe in sugar-coated 'progressive education'—and start right out with the most complicated part, the extraction turbine—although we keep this quiet and tell the beginner it's a fashionable new crossword puzzle. They find it interesting and it's the only phase of heat balance work that shows clearly the interrelation of all factors—how when you save something one place you're quite likely to lose twice as much somewhere else. When they get that through their heads they are on the way to being engineers, because they have learned to think and reason. We practically guarantee results to anyone with a working knowledge of the 3 R's and do not bar college grads, although we encourage only the most promising."

By RICHARD H. MORRIS

"MAC, this is the first time in 2 mo. that I've taken an evening off. Since we got that contract for machine gun parts our whole plant has been nuts getting things on a 24 hr. schedule. Right now we're running with no standby and have the plant tied together with baling wire and faith. Each shift begins with a prayer, we'd like to stretch this out to once a week or even once a day but we are afraid that Providence is just as insistent as the W.P.B. in holding down inventories."

"But you should be in a pretty good position to get what you actually need to keep up production, Andy."

"On paper we're tops—right up the list with collapsible brass gaboons and folding easy chairs for General Whoosit's field headquarters. But when there are no gaboons—the general waits until they are made up—no boilers, we do the same, only moreso because everybody and his brother had the same idea as we had—and earlier. Actually we're expecting a new boiler that will answer the purpose sometime this summer. We couldn't wrangle a turbine, that we have space for, but we did get hold of an old engine that's in pretty good shape. It should be in by next week, the foundation is all in, right where my office was."

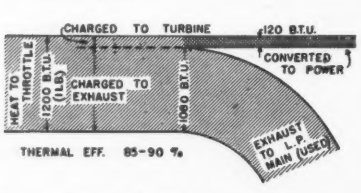


Fig. 1. The most efficient method of power generation is back pressure operation with the exhaust used for some purpose (heating, process or another lower pressure turbine) so it need not be charged against the turbine. A kilowatt-hour can be generated for from 3800 to 4000 B.t.u., representing a thermal efficiency of from 85 to 90 per cent

"If we actually lost a boiler perhaps we could get quicker action, but in our place that doesn't happen. If we lost the tubes we'd run on the drums, if we lost the drum my boys would have the water pipes dug up from the yard and a series boiler rigged up in the furnace before I heard of it. That gang is so good I have nothing to do but draw my pay and I'm getting ashamed to do that."

"You, Andy, are a vainglorious old goat—over at our place we have a layout like yours in one corner for practice—we don't let the boys work a regular shift until they can take it apart and put it together blindfolded! But come in when we can argue in peace."

"Wait a minute; a couple of my boys are parking the car and will be right in. The other day you made a monkey out of me about the heat balance because you talked so much I couldn't get a word in edgeways. We argue a bit at home about these things so I brought along some help tonight to keep you occupied while I talk."

"Mac, this is Mr. Davis—we call him Jeff because he's from the South and is so stubborn nobody has ever convinced him that the Civil War is really over. This long fellow is Clem Weston — a temperamental Western prima donna who either shuts up like a clam or talks your leg off. In his more loquatious mood you pick the subject and he'll argue either side, in fact, if you don't hold up your end he's apt to do a dialog and argue both sides himself."

"We argue a bit among ourselves and have half a dozen new plants on paper—nice fancy plants with all the gadgets and gingerbread we could hook on. It kind of burns us up to have all these swell plans and the first time we need more capacity we have to forget them and put up with makeshifts. However, this is getting us nowhere. We came over to tell you what's wrong with your 20 yr. old calculations—isn't that some of them out already?"

"Yes, Toby here is going to night school and came over with some questions. I was showing him some of the simpler ones and we were just getting ready to say good-night when you came. I thought the next batch, mostly on bleeder turbines, were a little over his head to be of much interest to him."

"Maybe you're right, Mac, but I don't think so. We have engines at our place, we like them and probably always will have them, but I tell you we got nowhere over at our place until we tackled the turbine. None of us ever had much to do with turbines, but an extraction heat balance is so graphic and shows the whole process so clearly that we all got interested."

"All one winter we worked them out like crossword puzzles—plotted the effect of different pressures and temperatures, heater location, bleed points, condenser vacuum, different methods of draining and everything else we could think of. After that the rest of the plant heat balance was so simple that we had them worked out in all foreign languages including the Scandanavian."

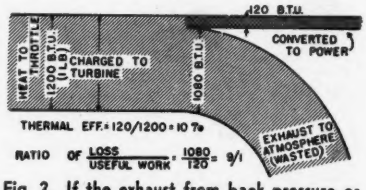

1120 B.T.U.
CONVERTED TO POWER
HEAT TO THROTTLE
1200 B.T.U. (1 LB.)
CHARGED TO TURBINE
1080 B.T.U.
THERMAL EFF. = 120/1200 = 10 %
RATIO OF LOSS / USEFUL WORK = 1080/120 = 9/1
EXHAUST TO ATMOSPHERE (WASTED)

Fig. 2. If the exhaust from back pressure or non-condensing operation is wasted the cycle efficiency is very low, around 10 per cent. The ratio of loss to useful work is about 9 to 1. Figures 1, 2, 3 and 4 are all drawn for the same operating condition, one pound of steam at 100 lb. per sq. in. ga. and 20 deg. F. superheat

"We had every B.t.u. spotted, in fact the boys used to wait for the coal cars to come in and tag each B.t.u. before it was fired. Later we worked out complete heat analyses for the engines, a much more complicated matter and one we would have been afraid to tackle without all the practice on the turbine. You said yourself that the heat balance was somewhat of a mystery to you to begin with—just when did it begin to have some real meaning to you?"

"Well, Andy, it's hard to look back that far and say definitely but I dare say you're right. Jim and I were working with engines at that time and had some pretty fair heat balances worked out. Simple ones but quite accurate considering the instruments, records and facilities we had to work with. But we never got very far on a detailed analysis of the engine itself—that was the reason we began on the turbine although neither of us had ever operated one."

"At that time we weren't really much better off with the turbine than

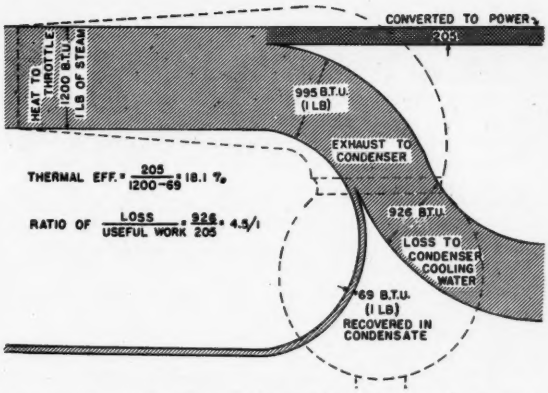

CONVERTED TO POWER
205 B.T.U.
HEAT TO THROTTLE 1200 B.T.U. 1 LB OF STEAM
995 B.T.U. (1 LB)
EXHAUST TO CONDENSER
THERMAL EFF. = 205/1200−69 = 18.1 %
RATIO OF LOSS/USEFUL WORK = 926/205 = 4.5/1
926 B.T.U.
LOSS TO CONDENSER COOLING WATER
69 B.T.U. (1 LB) RECOVERED IN CONDENSATE

Fig. 3. With condensing operation nearly twice as much power is generated from a given quantity of steam. A small amount of heat is recovered in the condensate and the net loss from the system is cut from 1080 B.t.u. non-condensing to 926 B.t.u. The thermal efficiency is increased to 18.1 per cent and the ratio of loss to useful work reduced to 4.5 to 1

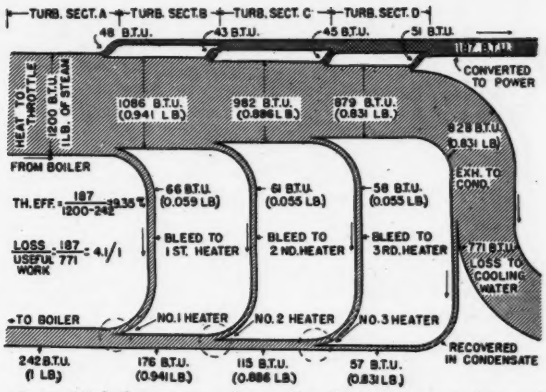


Fig. 4. With three stages of extraction the heat converted to work is reduced from 205 B.t.u. for straight condensing to 187 B.t.u., but the amount of heat recovered in the condensate is increased to 242 B.t.u., and the condenser loss cut to 771 B.t.u. The net result is an increase in thermal efficiency to 19.35 per cent and a decrease in the ratio of loss to usoful work to 4.1 to 1

with the engine although it was a little easier to visualize the action. Extraction turbines were just coming into use. Learned papers were being presented before engineering societies on why the extraction cycle was better, but they were a little over our heads. In fact as late as 1928 or 1929 a prominent engineer told me that there were not more than a dozen engineers in the country capable of working out an extraction heat balance. Perhaps he was right although Jim Perry and I were two he didn't count and there were probably a good many others who had puzzled the thing out for themselves."

"During the past 10 or 15 yr. the extraction or regenerative cycle in one form or another has been so widely adopted that its advantages are taken for granted and it's now quite completely covered in thermodynamic books. While this fact is accepted I still think there is considerable question in a good many engineers' minds as to just why it is so much more efficient than others and why it is effected by comparatively minor changes in equipment arrangement and auxiliary drive."

"Jeff, I take it you've worked on this considerably. Can you tell me the fundamental difference between the extraction and the straight condensing cycle and why it's more efficient?"

"Yes, sir, I think so—it's quite apparent if the two are drawn on a temperature entropy diagram. The effect of extraction is to transfer a triangular section of the condensing cycle from the right hand to the left hand side of the diagram. Drawn for saturated steam the ideal regenerative cycle is a bit askew, but it has the same areas and therefore the same efficiency as the Carnot cycle, which appears as a rectangle."

"But briefly, how does this shifting the area from one side to another increase the efficiency?"

"Why the condenser loss is decreased by using some of it to heat the feedwater."

"What about the area of the diagram, the part that represents useful work—how is that affected?"

"It's decreased. That's one of the paradoxical things that bothered me a long time in spite of the mathematical proof. For a given flow of steam, the turbine output is decreased with extraction, but the efficiency is increased. Also for a given turbine output you need a larger boiler, measured in pounds per hour, but the furnace heat input is smaller. Is that right?"

"You know it is, Jeff, as a matter of fact it's as concise a statement of fact as I've seen and I'm sure that amplified by a dozen or so strokes of a pencil it would be perfectly clear to anyone who knows his thermodynamics. However, what about the engineers who are rusty on thermo or never had the opportunity to study it? Also you admit that even after you know the thermodynamics the actual reason for some of these things was still rather vague. How would you explain it to someone with only a smattering of thermodynamics?"

"That's not really so difficult, several of our fellows had never even studied physics, we just kept working out straight condensing and then extraction heat balances until we convinced ourselves that some things just had to be so—after you do that a while it just kind of sinks in. Tell us how you and Mr. Perry worked it out by yourselves."

"Well, we didn't exactly do that, we both knew some thermodynamics although that particular cycle was not very prominent in text books of the first World War period. First we started with a back pressure or non-condensing cycle, as representative of both the lowest and highest possible efficiency. Then we worked through a straight condensing cycle and after a great deal of struggling, finally extraction cycles, beginning with very simple ones."

"Mr. Mac, how can the non-condensing cycle have both the lowest and highest possible efficiency?"

"That, Toby, was a loose statement. It can't be both at the same time. If you operate non-condensing and the exhaust goes to atmosphere it's all lost and the cycle efficiency is consequently very low. However, if you can use the exhaust out in the shop for some necessary use, perhaps for heating, you can credit the turbine with the heat in the exhaust. Then you say you have no exhaust loss at all and the efficiency is very high—you kind of skim off the cream and sell the skimmed milk. Do you see?"

"Not entirely. I don't see how what you do with the exhaust affects the turbine efficiency at all."

"It doesn't change the turbine efficiency, but it does change the cycle

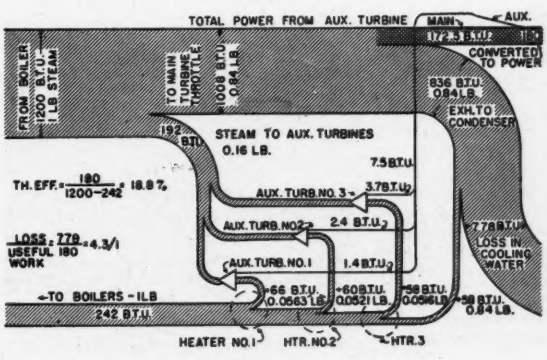


Fig. 5. Heat balance diagram for the steam driven auxiliary arrangement shown in Fig. 8 but with the water rate of the auxiliary turbines twice that of the main turbine. This and Fig. 4 give a direct comparison of the effect of turbine efficiency and shows that complete use of auxiliary exhaust does not always mean maximum efficiency

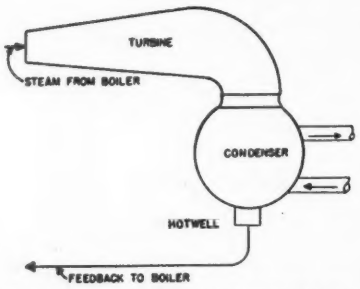


Fig. 6. In the straight condensing cycle (Fig. 3) all the steam passing the throttle eventually flows to the condenser

efficiency. The two are not the same for the turbine is one part of the whole plant. Suppose, for instance, that you were a man about town, with a family of three and you want to visit relatives in California. You could go on the railroad for they have ready made transportation to sell.

"However, you'd like to have a little more freedom than that, and, you'd also like to impress the relatives, so you decide to buy a car. You don't need the car afterwards so you find a friend who will buy it from you when you get back. You pay $1200 for a car, drive it 10,000 mi. out there and back and then sell it to the friend, who doesn't mind a second hand car, for $600. The transportation cost you 6 ct. a mile, which is about what three of you would have paid on the railroad.

"But suppose that while you were away your friend died and you can't sell the car even though you have no use for it. If you just left it on the street you'd have to figure that your transportation cost $1200 instead of $600, that is 12 ct. per mile. If you didn't want to do that you might just keep it in the back yard and drive it occasionally, say another 10,000 mi. over a period of 6 or 8 yr.

"By that time it would be so old that all you can do is sell it to the junk man for, say, $25. By this time you would have had 20,000 mi. of transportation at a cost, less gas and oil, of $1175 or a trifle less than 6 ct. per mi. That is by keeping it and driving it occasionally when you could you've kept the cost per mile down to about half what it would have been if you just abandoned the car on the street. Of course this extra 10,000 mi. cost something additional for gas and oil so its not all gravy. As to the $1200 you could suit yourself as to whether you charged it all against the California trip and considered the second 10,000 mi. free transportation or whether you distributed the whole investment over the 20,000 mi.

"It's the same with steam. Here in Fig. 1 we are operating non-condensing because we want some power and don't want to buy it from the utility company for some reason or other. We'll say we are using 100 lb. ga. steam with about 20 deg. of superheat so that each pound has about 1200 B.t.u. The turbine efficiency is such that 120 B.t.u. of this is converted to power, turning the turbine shaft. The balance, or 1080 B.t.u., except for a little radiation and bearing loss which we'll forget about now, goes out the exhaust.

"Now those B.t.u. are just as good as ever for low temperature heating and if you can sell them to the foreman out in the shop, your power has cost you only the 120 B.t.u. which the turbine converted to power. Actually considering loss from radiation, leakage, bearings and the generator, this method of operation will give a kilowatt-hour at from 3800 to 4000 B.t.u. per kilowatt hour or 85 to 90 per cent efficiency which is very high. Of course this second hand steam isn't worth as much per pound to the shop man, but it is worth just as much on a million B.t.u. basis.

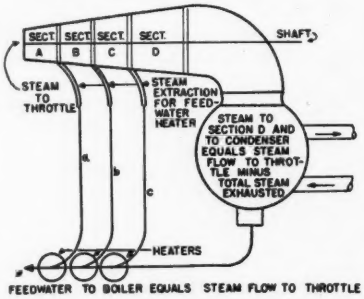


Fig. 7. In the extraction cycle, only part of the steam passing the throttle reaches the condenser

The reason for the higher efficiency of the extraction cycle is easier understood if the turbine is split into several sections. In the above machine, drawn for three stages of extraction, Sections A, B and C operate at very high efficiency comparable to the back pressure operation shown by Fig. 1. All the steam entering each section is either recovered in the feedwater or passed on to be used in the next section, the only loss being a small amount from radiation and bearings. All the condenser loss is thrown on the last section D, but the steam flow to D is less than that passing the throttle by the amount a + b + c. For a given steam flow to the throttle less power is generated than in Fig. 5 because a, b and c pass only part way through the turbine. This difference in power output is shown by comparison of Fig. 3 and 4

"If you can't sell the exhaust to him you have to let it go to waste. Then your turbine must be charged for the full 1200 B.t.u. as in Fig. 2 and the efficiency is 120/1200 or 10 per cent. This is the same as when you came back from California and left the car on the street because you didn't want to be bothered with it."

"Some times you can sell part of the exhaust, just as you might rent the car occasionally. However, wasting all or even part of that steam is objectionable to neighbors and has other disadvantages. Therefore if you can't sell the exhaust you might arrange to operate condensing as in Fig. 3. This is an improvement because the turbine, operating clear down to condenser pressure, has a chance to extract 205 instead of 120 B.t.u. from each pound of steam that passes the throttle. That extra 85 B.t.u. corresponds to the extra 10,000 mi. you drive the car after you discover you can't sell it. The extra condenser cost is your gas and oil charge and except for this the 85 B.t.u. is gravy. Also you recover a few B.t.u. in the condensate from the hotwell and this corresponds to your $25 salvage on the junked auto. Your efficiency is then 205/(1200-69) which is 18.1 per cent, a very creditable improvement over Fig. 2."

"Now you've worked yourself into a corner, Mac, let us see you hook this auto deal—which I am sure Mr. Henderson of OPA would not approve of—up to the extraction cycle."

"Don't be hasty, Andy—I worked that out years ago on my old Maxwell —and with a modern trim it goes like this: On this swell new auto you have some high class trimmings, fog lights, a radio and a heater. If you keep them until you junk the car they will be so far out of date that they are of no value and you'll only get perhaps $1 or $1.50 more than the $25 which you would get from the junk dealer for the stripped car.

"After you've been home a year or so you find you're not driving at night so you peel off the fog lights—chromium and all—and sell them for $25. That reduces your investment cost from $1200 to $1175. A while later you get annoyed at the jitterbug music from the radio, or perhaps politics, and sell the radio for another $25. That cuts your investment to $1150. Finally, you stop driving in cold weather and peddle the heater for another $25, leaving only $1125 as the cost of that California trip and that is cut to $1100 by the $25 from the junk dealer. Follow me?"

"Oh! I'm ahead of you—but tell the boy why you don't peddle them all at once instead of piecemeal."

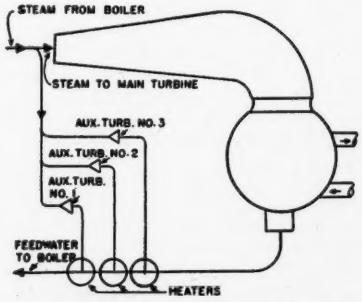


Fig. 8. The equivalent of an extraction cycle using one main and several auxiliary turbines

Cycle efficiency of an extraction unit with all motor driven auxiliaries would be equalled by a straight condensing unit and steam driven auxiliaries if: (1) the efficiency of the small turbines equalled that of the main turbine; (2) the auxiliary loads could be balanced so that there was just sufficient exhaust to heat the condensate; and (3) the different auxiliary turbines could be operated satisfactorily at different back pressures

"Then I wouldn't have the use of them in the meantime. Take Fig. 7 here. The effect is quite apparent if you consider your extraction turbine divided up into four sections. All the steam goes to section A and is exhausted. Before entering Section B

(*Continued on Page* 126)

Fattening ALGAE FOR THE KILL!

Photograph of algae samples in Nalco Research Laboratories

ALGAE are nurtured in the Nalco Laboratories —kept on hand for use in experiments that spell [illegible] doom. For it's through such laboratory research that Nalco has been able to develop controls to end the nuisance and cost of algae, slime and bacterial growths in water used for industrial purposes.

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Questions And Answers

Question No. 170

The Flyash Has W. L. In a Tight Spot

Some of the readers of P. E. & E. may be able to unlimber the old brain and give me some suggestions and ideas that will pull me out of a tough spot. The problem consists of eliminating flyash from our boiler installation, without expensive precipitators.

We use spreader type stokers in combination with forced and induced draft and short stacks which it is impossible to make higher. I have some type of gas washer in mind, but would appreciate some other engineer's idea on the subject before going ahead. W. L.

Question No. 171

Will a Steam Compressor Help Him?

We operate a 125-hp. boiler, at about 120 per cent capacity, to supply a 70 hp. Chuse engine driving a direct connected 50-kw. generator. We heat all our wash water (about 25,000 gal. daily) two dry rooms, laundry tumbler and feedwater with exhaust steam and still have a surplus of exhaust steam which is vented to the atmosphere through a relief valve. All our water comes through a Zeolite softener.

We would like to install a deaerating feedwater heater using our softened water for make-up in conjunction with condensate from the steam exhaust after it has gone through the water heaters, tumblers and dry rooms.

If possible we would like also to install a pump that would put steam as well as condensation back into the boiler. We have tried passing steam at a high rate of speed through our mangle and find it speeds production about 30 per cent, therefore we would like a circulating pump that would circulate our steam through machines and back to the boiler.

Fulton, Ky. P. R. Q.

Question No. 172

It Just Can't Happen Here!

Q. Would you please answer the following question as I have been unable to find a satisfactory answer in any of the textbooks available to me.

We are operating a conventional type rapid sand filter job in connection with our power plant and it is desired to furnish water to a zeolite softener at a pH of 7.1. Water leaving the first settling basin has a pH of 5.8 and the pH correction is made by the use of caustic soda. However, to have an effluent from the sand filters of pH 7.1 it appears necessary to maintain a pH 8.0 to 8.5 in the water on top of the filters.

The temperature of the water throughout its travel is maintained at 80 deg. F. at its start and reducing to about 76 deg. F. by the time it reaches the clear well. Filter alum is used as a coagulent.

Why is it necessary to maintain a pH value of from 8 to 8.5 at the top of the filter in order to get filtered water with a pH value of 7.1?

E. L. E.

A. This problem presented by E. L. E. is a difficult one to answer because it is one of those things that just can't happen here. Passing water through a sand filter should not result in any chemical changes at normal temperatures.

Assuming that all errors due to faulty technique or deteriorated pH equipment has been eliminated, then the change in pH value can only be caused by physical means, and the only physical change is the filtration of the water.

If sufficient caustic soda is being added to this water to raise the pH value to from 8.0 to 8.5, it is possible to produce a colloidal suspension of calcium carbonate and/or magnesium hydroxide.

An unfiltered sample of this colloidal suspension would undoubtedly show a higher pH value than a filtered sample and it is suggested that samples of this water be taken and filtered through several thicknesses of filter paper and again tested to determine the pH value.

Even the above discussion does not entirely satisfy the data because a pH value of 7.1 that was noted in the filtered effluent is an indication of the presence of free carbon dioxide and free carbon dioxide would react with colloidal calcium carbonate or magnesium hydrate and the filtration as described above would result only in a too sudden change in the pH value.

Filtering out of the colloidal matter and the resultant after reaction would be more apt to change the pH value from 9.0 to 8.3 and this could easily be what is happening if the equipment used in making the pH determination is faulty.

Use of alum will of course reduce the pH value because its reaction is acid and it may be that the pH value of 8.0 to 8.5 is based on samples of water that have not yet been treated with alum, or, it is possible that small particles of alum are being carried into the filter and are going into solution in the filter and thus reducing the pH value. A pH value of 8.0 to 8.5 in the final coagulated effluent is normally not satisfactory for alum coagulation. The optimum pH value is generally in the vicinity of 7.0 or lower.

A more comprehensive answer would require a detailed study of the flow diagram and arrangments for analyses of various samples to determine exactly what is happening for it is evident that there is something wrong in E. L. E.'s observations or testing technique.

The Permutit Co. H. L. Bowers
New York, N. Y. Service Manager

Question No. 173

His Compressor Pumps Oil and Frosts Badly

Q. We have a 9 by 9 in. single-acting, 2-cylinder ammonia compressor with which we have had a great deal of trouble both from pumping oil and excessive frosting. This machine was recently overhauled with a complete set of new 2-piece rings and new valves. The $\frac{3}{32}$ in. oil drain holes around the skirt of the piston are clean with the oil wiper ring in good condition.

We have used oil supplied by the manufacturers but find that we get no better results as far as oil pumping is concerned with this than we do with any other oil. In addition to pumping the oil, the machine frosts badly from the water jacket to the foundation, although we carry only about 3 in. of ammonia in the receiver glass.

We would appreciate any suggestions that would help us with these troubles.

H. B. N.

A. Excessive frosting of the compressor is unquestionably due to a faulty liquid control which allows an excessive amount of liquid to be fed to the evaporator from where it is carried to the compressor in the liquid form.

Excessive frosting, in this particular case, would indicate constant liquid carryover from the evaporator to the compressor and presents a very dangerous situation since considerable damage can be done to the compressor if this operating condition is allowed to exist over any length of time. Correction should be properly made to insure the delivery of the proper amount of liquid refrigerant to the evaporator and dry gas to the compressor.

In this case the liquid pumping may have a direct bearing on the oil pumping since the depositing of liquid in the crankcase of the compressor will create a tendency for the removal of oil from the crankcase to the system.

Therefore, the liquid refrigerant carryover from the evaporator to the compressor should be eliminated first, because it is dangerous to the compressor itself and second, because it probably has a direct bearing on the quantity of oil pumped from the compressor crankcase.

CONSIDER THESE IRON BODY VALVES TO SAVE BRONZE

THE "KING-CLIP" — a husky iron body gate valve which employs bronze for the internal working parts only. For many services, the "King-clip" will serve equally as well as a bronze gate valve. Easily taken apart for cleaning. A valve that withstands hard and continuous usage.

THE "FERRENEWO" — an iron body globe valve that may be used instead of bronze valves for many services. All internal parts are made of non-corrodible alloys and are renewable. Seat and disc are regrindable. The "Ferrenewo" will give excellent service with negligible upkeep cost.

Investigate the adaptability of these iron body valves to your needs.

Fig. 1640
"King-clip" Gate Valve
150 lb. S. P.

Fig. 1021
"Ferrenewo" Globe Valve
150 lb. S. P.

ESTABLISHED 1862
THE LUNKENHEIMER CO.
"QUALITY"
CINCINNATI, OHIO, U. S. A.
NEW YORK CHICAGO
BOSTON PHILADELPHIA
EXPORT DEPT. 318-322 HUDSON ST., NEW YORK

Since virtually all materials used in the manufacture of valves are on the list of critical materials, valve users are urged to furnish the highest possible preference ratings on their orders. This will be of mutual helpfulness.

LUNKENHEIMER VALVES BOILER MOUNTINGS LUBRICATING DEVICES

Other possible reasons for the excessive oil pumping is first, excessive wear of cylinder walls, pistons and piston rings; second, lack of a proper oil wiper ring in the bottom groove of the piston; third, operating with abnormally high oil pump pressure or the injection of an excessive amount of oil to the cylinder walls for cylinder wall lubrication.

Rapidly changing or fluctuating suction pressures may also induce an oil pumping tendency. The general hookup with the equipment in this system may also be a factor. D. F. HILL

Answer to Question 146

Testing For pH

WHAT are the customary methods of determining the pH value of boiler feedwater asked Allen S. Hunter on p. 96 of the December, 1941 issue. Answers to this question follow. (Editor's Note: Reference should also be made to the extensive article on this subject—Acidity and Alkalinity Measurements by W. A. Taylor—which appeared on p. 64 of the March issue.)

The Colorimetric Method is Simplest

SEVERAL chemical reagent and apparatus manufacturers have test sets on the market for the determination of the hydrogen ion concentration (pH value) of boiler feedwater. These test sets offer a satisfactory and inexpensive method of determining pH values where an accuracy of no greater than 0.2 pH is required. This is usually sufficiently accurate for power plant control work. The method employs the use of color standards made up in the form of colored solutions in sealed glass tubes.

When the chemical indicator, included in the test set, has been added to the water under test, the water changes its color to red, orange, yellow, green, blue or violet, in varying shades, depending on the degree of acidity or alkalinity of the water being tested. The test tube containing the water under test is placed behind an etched glass window in a special holder. A color standard in a sealed glass tube is placed on each side of the test tube of water and the holder is held up to the light.

Color standards are changed until a color is found which matches the color of the water on test, or until two colors are found between which the color of the water lies. Since each standard color has the equivalent pH value marked on the glass tube, the pH value is easily and speedily determined by color comparison.

Another type of test may also be used. Instead of color standards made up in sealed glass tubes, a disc containing smaller colored discs is mounted in a similar holder as previously used. The test tube containing the water on test is held up to the light and the disc rotated until the color of the solution and the color of the disc nearly or actually match. The pH value of the water is then read directly from the disc.

When the color of the water under examination is extremely dark or cloudy, colorimetric methods of hydrogen ion concentration determination cannot be used and electrometric methods must be used. Such apparatus is costly, and the investment hardly seems warranted for ordinary control in the average power plant.

If the boiler feedwater is dark or cloudy, however, the author has found that by merely filtering the water through disc filter papers, enough of the color can be removed so that either of the first two methods of pH value determination may be used without difficulty. Virginia Polytechnic Institute,
Blacksburg, Va. JACK EVANS

It Is Also Easily Used

AT OUR PLANT the method in use for pH testing is as follows: 1. Draw a sample of water to be tested. 2. Fill a graduated glass beaker with 10 c.c. and add 1 c.c. of pH indicator. 3. Agitate and compare the sample with a color chart. This gives the approximate pH value, which, while not an exact value, is, we believe, close enough for all practical purposes.

Necessary materials can be obtained from most any chemical house and, I believe, are not expensive, although I have never had occasion to find out the cost. We use Gramercy Universal Indicator, H.50 furnished by Eimur & Amend, of New York City. They also furnished the comparator chart.
Mechanicville, N. Y. R. F. LEACH

Letters And Comments

A Tribute to the Operating Engineer

THIS LETTER may be laid on the doorstep of those supermen who in their lectures, writings, technical papers and engineering essays, use the poor operating engineers and firemen as a screen while making a hasty back door exit after having pulled a boner.

Very few of the "able men of experience" who feel called upon to write "helpful articles" for their fellow men will give us a kind word. No matter how difficult it is to make a pulverized fireman (the word coal is omitted advisedly) out of a stoker fireman, or a turbine man of an old fashioned reciprocating engineer, these college trained wizards still owe their bread and butter to the operating men who keep their contraptions percolating while they "iron out a few kinks."

Every manufacturer seems to have an endless supply of these and Al Iddles (p. 86 March issue—So You Want A New Plant?) seems to fit well into the pattern. Someday one of these is going to say "the patience, experience, ability and co-operation of the operating staff was of immeasurable value in getting the plant up to its present point of efficient and dependable operation." I write the above bouquet in case "someday" is not in our lifetime.

RICHARD L. SMITH, JR.

MR. SMITH'S comments upon my paper presented before the Midwest Power Conference in April, 1941, are interesting to me. He plainly sets forth a reason why I should write another paper, since the other phases of the co-operative effort necessary to do this power job in a first class manner were not intended to be covered in my talk to the Power Conference.

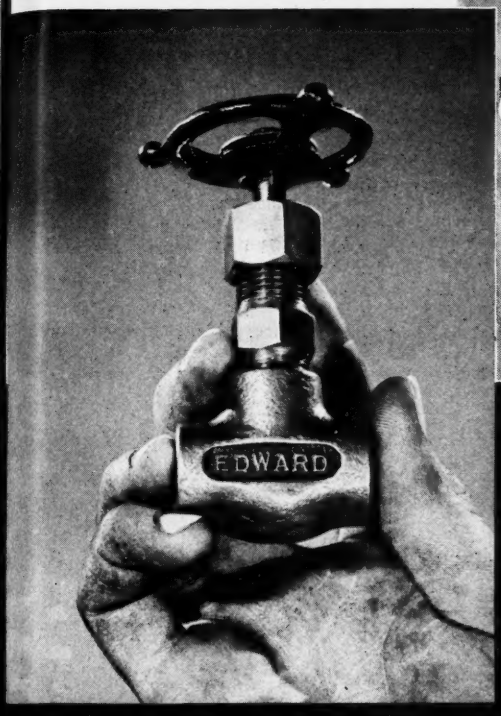
In your magazine article you changed the title, but as originally written and given it was—"The User Wants to Know"—and the burden of the discussion was intended to point out to the owners, or others in control of selection of equipment, some of the problems which it seemed to me were not sufficiently considered in many instances.

The fact is that only this week I gave a somewhat companion discussion before the Metropolitan Section of A.S.M.E. and the title was—"What the Operator Wants to Know." I wish Mr. Smith could have heard that discussion because some of this criticism I believe was taken care of in a manner which would have been pleasing to him.

Specifically, the purpose of my discussion at Chicago was to endeavor to establish a belief on the part of the owner that he should give the operator proper equipment, operating instruments, and sufficient qualified personnel to adequately care for the power plant. I had intended to be helpful to the operator in so doing and I am naturally sorry that Mr. Smith obtained a somewhat different impression from the words which I used.

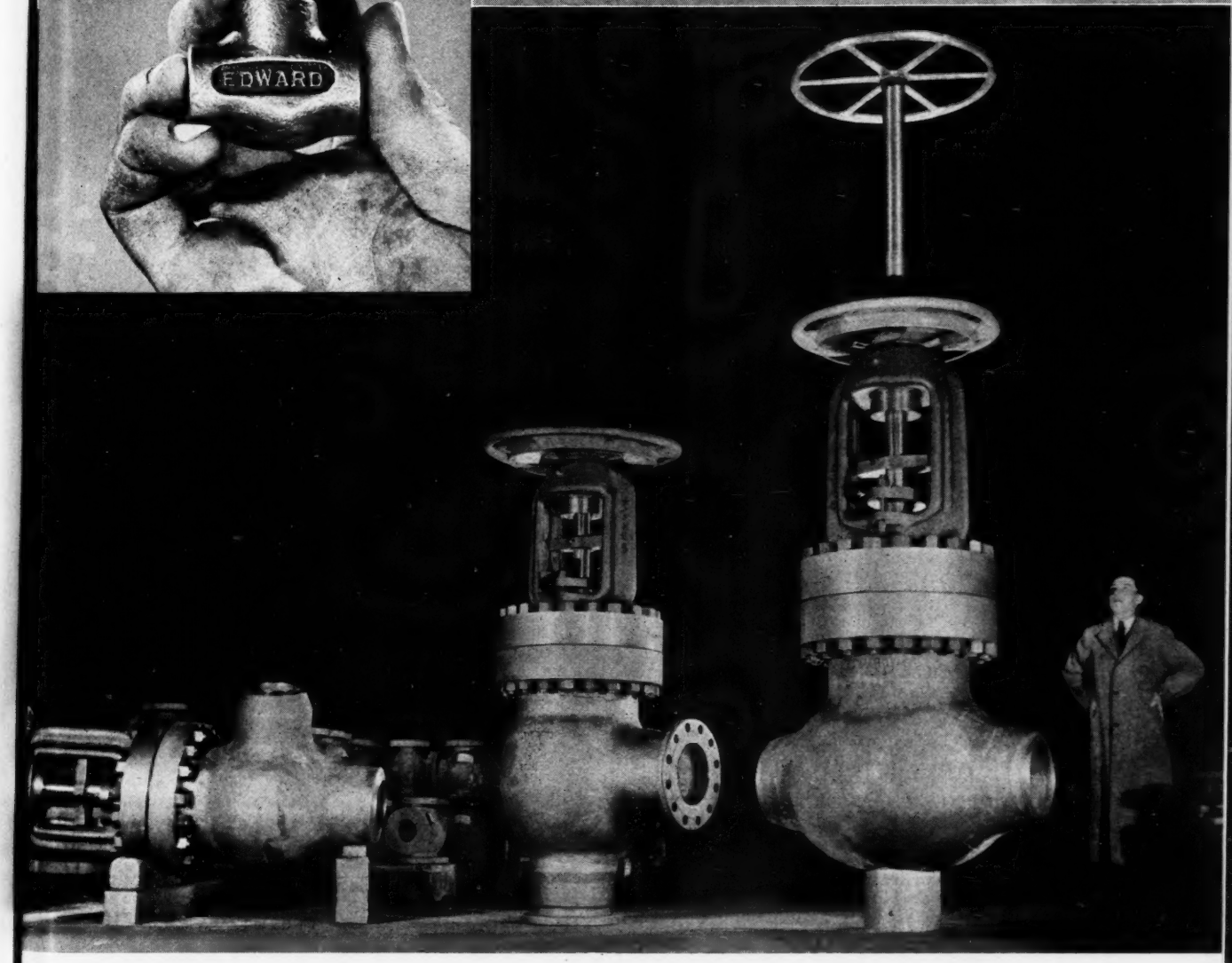
In fact in your briefing the talk as originally printed, you omitted one paragraph in which I paid tribute to one type of operator when I said that —"When a question was being discussed with the superintendent of a station recently concerning the methods of repair and replacement, his basic answer was 'If I can get at it, I can fix it.' I have never seen the superintendent in that plant wait for the arrival of the manufacturer's representative before beginning the disassembly of some equipment that needed attention."

This is representative of the true



"BABY" OR "GIANT"

EDWARD *PLUS VALUE* VALVES MEAN MINIMUM MAINTENANCE



THE EDWARD VALVE & MFG. CO., INC.

EAST CHICAGO INDIANA

BIG or little, Edward valves are built to stay on the job — without constant attention. Today, when time is so precious and operating interruptions so costly, Edward dependability is more important than ever. All Edward valves have one thing in common — basic fitness for tough service. The tiny ⅛ in. forged steel gage valve for many services (upper left) and the gigantic 10 in., 12 in., and 14 in. alloy steel valves for 1500 lb, 950 F service are built to equally exacting specifications. Sound design, careful selection of performance-proved materials, painstaking workmanship and rigid inspection at every stage of the manufacturing process — these are the principles behind Edward's tradition of "plus value" valves.

EDWARD *Steel* VALVES

CAST AND FORGED

operator, whose attitude is that which Mr. Smith has outlined and basically involves the assumption that it takes two kinds of people to bring a power project to a satisfactory conclusion. The first is the designer, who usually is a part of the manufacturing personnel or of the consulting engineer's organization, and the second is the operator who must live with the good and the bad that results from the best efforts of the designer.

Believe it or not, I am personally very much aware of the painstaking effort and endless work which the operating men provide as their share of the project as a whole.

I can very truthfully and gladly say (if Mr. Smith will permit), the quotation which he suggests—"the patience, experience, ability and co-operation of the operating staff was of immeasurable value in getting the plant up to its present point of efficient and dependable operation."

ALFRED IDDLES

Washington Is That Way

Editor's Note: Anyone who has lived in a boom town can appreciate present day Washington—the rush and bustle, uncertainty of where you can eat and sleep and what the next day will bring, the sense of tension and nervous efforts to relax.

Quiet, sedate Washington in peacetime is impressive and beautiful. The steady throbbing pulse of a young and vital nation is evident, with just sufficient reminder of the past to leave no question but that the nation, while young, has tap roots long and deep in the solid past. No American can visit Washington without a thrill of pride for what it represents.

Comparatively few of the 130,000,000 Americans have had the opportunity of visiting Washington during the past few months, however, and past visits make it difficult to appreciate the increased tempo, the congestion, and growing pains brought on by the war.

The following sentences taken more or less from random from a longer letter written by Kingsley Rice bring out some of the highlights. The letter was in long hand appended to a report of a conference. Without knowing more of the circumstances we venture a guess that its real purpose was a mental sedative—an attempt to quiet down the events of a busy day as a preliminary to sleep. Once down on paper they cease whirling around in one's head, and give the sandman a chance to do his stuff!

DEAR DICK:

Either one's perceptions are heightened in the Nation's Captitol or there really are more unusual things to see here. Perhaps this is why everyone who comes to Washington sooner or later becomes imbued with a desire to write a column of "Intimate Glimpses" or "War-Time Minutes" or some such "Brisbanian" chatter.

For instance, they have here, because of the transportation jam, a taxi system called "emergency pick-up." A cab driver going out Connecticut Avenue, for example, will put up an appropriate cardboard sign and if you want to go out Connecticut Avenue you hail him even though he already has a fare.

In that way you meet many interesting people. Yesterday I finally snagged a cab at the Willard and before the door closed a snappily dressed, French-looking woman piled in too. She was going my way and talked incessantly for twelve blocks with an accent like a female Charles Boyer, making me feel like the male lead in "Mata Hari" for a few minutes. . . .

Street names result in many queer combinations on the busses like the impossible one, "Georgia and Alaska" and the intriguing "Seat Pleasant." Even the bell hops seem to be in a gay and independent mood. One came through the Coffee Shop the other morning paging "Mr. Brown" and adding, in only a slightly lower voice, "went to town." . . . I met Congressman Luther Patrick from Alabama at a party the other night. He's the Walt Whitman of Congress and regaled us for a couple of hours with original poetry. Washington parties, by the way, seem to grow like Topsy.

At dinner last night we ended up with an ensign, a girl who works in the F. B. I., a director of the Small Grain Division of the Department of Agriculture, an ex-congressman now a quartermaster captain, the secretary of the Press Club, the publisher of a Milwaukee grain magazine, a leather man, a man from F. H. A. and a few others I can't recall. . . .

The government telephone system is marvelous. If you're in a government department you merely pick up the phone and say "government." In a second a sweet voice says "government." Then you say "Army", "Navy", "Maritime Commission", "WPB" or whoever you want and you get your man in no time. Some times it gets crossed up, though, like a call to the OPA today which ended up in Detroit by mistake. I am told that the War Department has the largest telephone switchboard in the world. . .

Quite a town.

KING

The Engineers' Primer. III

(Continued from Page 120)

you peel off a strip "a"—that's your fog lights. When you peel this off you beat the junk dealer, who is now the condenser, but you lose the power that steam would have generated if it had been allowed to go through Sections B, C and D of the turbine.

"All the steam minus that peeled off at "a" goes through Section B and then you peel off another strip "b"—that's your radio. Then through Section C and off comes "c"—the heater. Finally what is left goes through section D to the condenser. Most of the heat that is left is lost to the condensing water but a small amount is recovered in the condensate—that's the $25 salvaged from the junk dealer. The condenser loss is your depreciation or first cost less the salvage value.

"If you compare Figs. 3 and 4 you'll see that the power extracted from the pound of steam has dropped from 205 B.t.u. for the straight condensing cycle to 187 for the extraction cycle. However, the condenser loss has been reduced from 926 to 771 B.t.u. with most of that big difference being absorbed in the condensate. Crediting the turbine with this recovered heat, the efficiency has been increased from 18.1 per cent for the condensing cycle Fig. 3 to 187/(1200-242) or 19.35 per cent for the extraction cycle, Fig. 4."

"One more question, Mac—if you can peel off three accessories why not strip the car completely?"

"Well, there's a limit to the stripping you can do and still run, and there's a limit to the amount you can bleed off because the condensate can absorb just so much heat. The idea is to bleed off the heat where is will do the most good and reduce the power output the least. From the standpoint of cycle efficiency it is best to bleed off very small amounts at an infinitely large number of places.

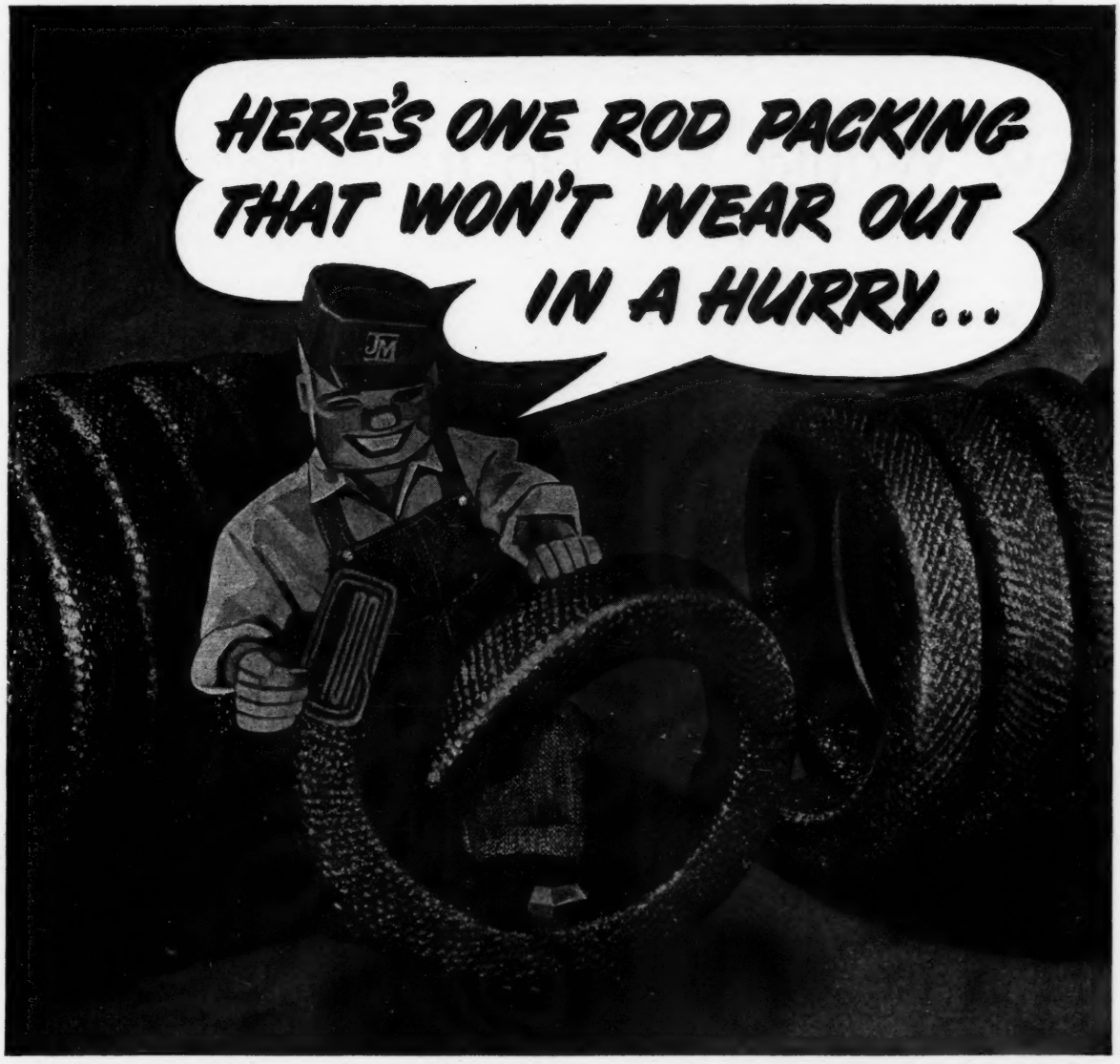
"Practically there is a limit to the number of heaters possible to use. Turbines have a very definite number of stages, perhaps 15 to 20 at the most and the best you could do would be to have a heater at every stage. Heaters are expensive, however, so cost sets a further limit on the number that is practical, usually this will range from three to five."

"Mac, I've heard a lot of outlandish things in my time but that takes the cake. Toby, if you don't mind being used as a guinea pig will you tell me if it meant anything to you?"

"Well, sir, how Mac picked some of the figures out of the air is a bit hazy, but I understand about hanging onto the steam as long as possible in order to use it. You see I had to sell my heater the other day to get enough for the next payment on my car but I managed to stall along until the cold weather was practically over."

"Mac, you win—this was as good as a movie and we'll be over for the next show soon. If it's as outlandish as this one I'll go out and sell my car now before I find myself selling it one piece at a time to see if your figures check. And you, Toby, needn't worry too much about where the figures came from. If you get the general idea Mac can show you how to fill in the figures. It looks complicated but actually it's as simple as going down to the grocery store and checking the bill to be sure you haven't been cheated. When is the next act, Mac?"

"Glad to have you any time but the next show is yours—I want to hear and see a practical demonstration of your 'sugar coated' method of proving that 'when you save a bit here you're apt to lose a bit there.' Not too deep—say the difference between: open and closed heaters; cascading or pumping the drains; and why a motor driven auxiliary will show a better heat rate than a turbine drive even though all the turbine exhaust is used."



J-M KEARSARGE LASTS LONGER... CUTS RE-PACKING COSTS

For continued efficient service against high-pressure steam, you can't beat this rugged rod and plunger packing.

Its unique folded construction provides natural resiliency and forms a reservoir for the preserving lubricant, keeping the packing pliable in service. Additional resiliency is provided by a red rubber expansion back in the center block. And resistance to wear is assured by a double wrapping of asbestos cloth.

You can use Kearsarge Rod Packing, together with other packings and gaskets in the complete Johns-Manville line, to minimize equipment shutdowns . . . save much of the expense and loss of production caused by too-frequent *re*-packing. For details, ask for the new J-M Packing Catalog. Johns-Manville, 22 East 40th St., New York, N. Y.

JM PRODUCT

Johns-Manville PACKINGS & GASKETS

THERE'S A DISTRIBUTOR NEAR YOU

Problem 21. Coal Segregation in a Stoker Hopper

How Would You Do It?

DEEPLY CONSCIOUS of their dignity and responsibility, the venerable Judges carefully trimmed their beards, donned and adjusted the judicial robes and filed into the council chamber. There they debated, deliberated, decided and finally declared the awards on Problem 21.

This problem, dealing with coal segregation in the hopper of a stoker fired boiler, was outlined fully on p. 104 of the March issue. The layout is shown in Fig. 1 and, in brief, the difficulty may be stated as unsatisfactory furnace conditions, because the two outside retorts received all the coarse coal and the three center retorts all the fines.

Segregation in storage piles, bunkers, chutes and hoppers has always been a troublesome problem and has been subject to a great deal of amateur and professional investigation. In locations where the segregation action can be observed conditions can often be materially improved by simple baffles. Where the action cannot be observed the problem is more difficult and rather elaborate mechanical methods are sometimes used to combat the trouble.

One may say, without fear of serious contradiction, that no approach was made to a fundamental solution until it was appreciated that segregation can occur even in a distributor kept full of coal, if, adjacent coal streams are moving relative to one another.

When this was appreciated the solution was simple and direct, along two general lines: 1, designing the distributor with equal paths of travel to the discharge end; and 2, using a variable cross section so that the coal advanced on a parallel front. Either can, of course, be made to utilize the self segregation action of flowing coal to correct, within narrow limits, segregation present at the entrance to the distributor.

It must be remembered, however, that a distributor of this type is not a coal mixer and its function is to deliver coal as received and not correct poor distribution or segregation which occurred in some previous section of the coal handling system.

First award was based on an evident appreciation of the problem involved and the solution considered in the light of present conditions. The change suggested is a minor one, involving little lost time, expense or material. The single plate removed can be re-used and in most plants the additional plate needed can be found in the scrap pile.

The second award shows an equal appreciation of good engineering, but it involves more extensive change, namely, raising the present coal scale and purchase of a new distributor, which, with all steel going into war industries, might be difficult for some plants to arrange. While the problem states that room is limited it does not state specifically that the scale cannot be raised, although one might infer that, if such a course had been practical, it would have been done originally.

Deflector plates as suggested in the third award have been used effectively in the past and the adjustable plates offer increased flexibility to meet actual operating needs. Operating with the coal level below the plates would offer difficulties in operating the scale, and, with the coal level above the plates the possibility of the coal hanging up might well be a factor worthy of consideration.

Vibrators attached to hoppers and chutes have done much to obviate this difficulty, however. In fact one reply to the problem suggested that vibrators alone might well offer a cheap and practical solution of the problem—a suggestion at least worthy of trial and experimentation.

FIRST PRIZE AWARD

Philip B. Richardson
Richardson Scale Co., Clifton, N. J.

SEGREGATION occurring in the distributor shown in Problem 21 is due to the following reason:

Because it is further from scale to stoker down the outside of the distributor, the coal progresses through the distributor faster at the outside than down the center. In fact the coal in any line of flow runs faster in proportion to the distance which its line of flow is removed from the centerline of the distributor.

When there are two lines of flow or streams of coal adjacent and flowing in the same direction, but flowing at different speeds, the lumps in the slow stream will tend to roll into the faster stream and the fines of the faster stream will tend to be pushed into the slower stream. This is due to the angle of repose of the lumps being a lesser angle (to the horizontal) than the angle of repose of fines.

The way to prevent lumps rolling to the outside, or the faster streams, and the fines segregating in the center, or the slower streams, is to even the speed of all lines of flow. If all lines of flow run at the same speed the lumps and fines will not segregate.

To even the speed of the lines of flow it is necessary to depress the top of the distributor at the center. Since the stoker takes the same volume of coal from the center of the distributor as from the outsides it is obvious that a reduced distributor height at the center will make the coal run faster down the center. Therefore to solve this problem I would suggest the following:

Cut out the top side plate of the distributor. Then strike an imaginary line, A-B of Fig. 1, parallel to the centerline of the bottom side plate, but 10 in. above it, and, on the centerline of the distributor when looking at the front of the scale. Then from the centerline of the bottom of the scale, strike another line C-D perpendicular to the centerline of the bottom side plate. Lines A-B and C-D will intersect at E, giving lines C-E-B in the side elevation.

Build in a new top in four planes using lines C-E-B and original top side. If the original top side plate had corners W, X, Y, and Z the new top side will consist of four plates:

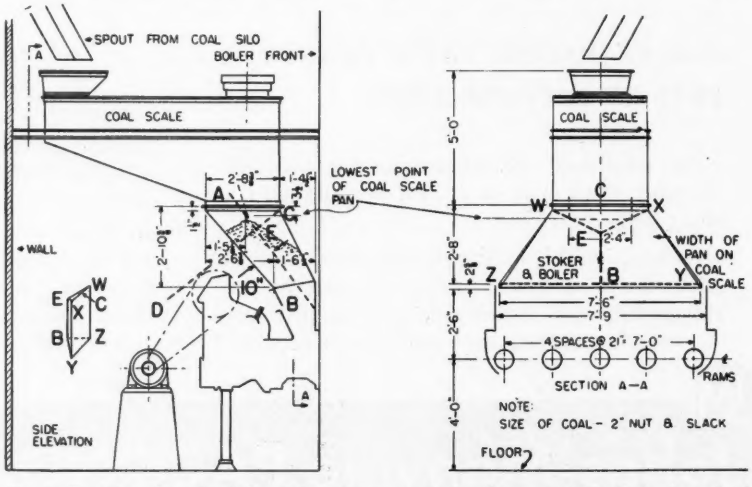
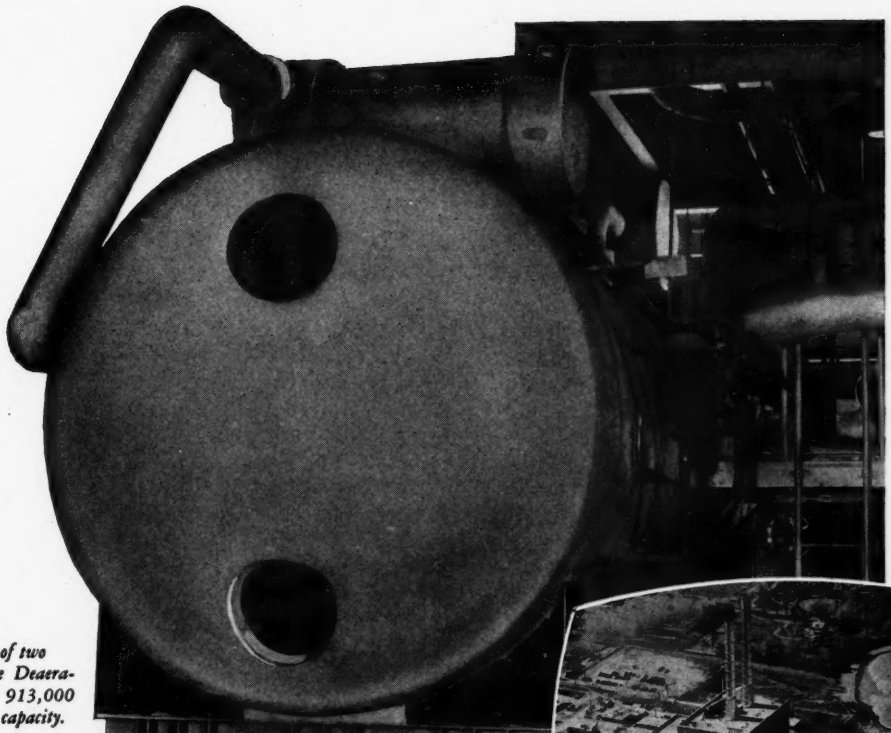
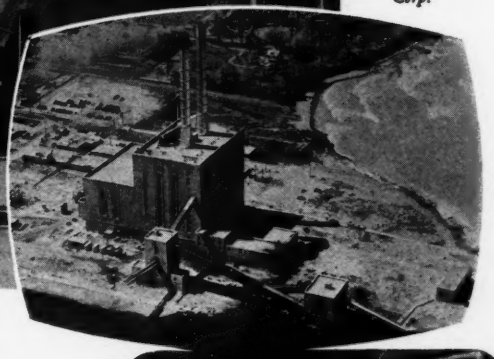


Fig. 1. First Prize Award solution is based upon replacing the present distributor top plate with a special section designed to give a thinner coal stream in the center than at the edges. The special section is hard to visualize and the small isometric view shows the surfaces involved inadequately. A cardboard model can be cut out in a few minutes to show the suggested arrangement very clearly



One of two Cochrane Deaerators of 913,000 lb./hr. capacity.

(Below) Air view of Oswego Steam Station of Central New York Power Corp.



OSWEGO UNITS NOS. 1 AND 2

CENTRAL NEW YORK POWER CORP.

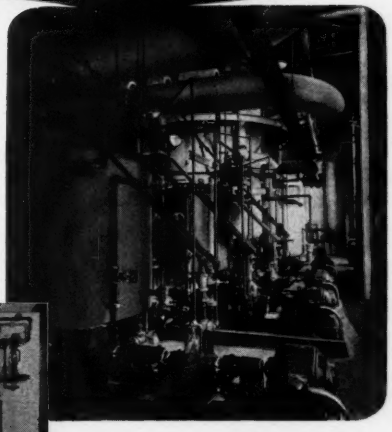
rely on Cochrane Softening & Deaeration

THE Oswego Steam Station of the Central New York Power Corporation has had one of its 80,000 kw. units installed for over a year, and the second was recently placed in operation.

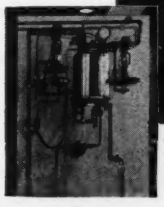
Both these units use Cochrane Feedwater Conditioning Equipment. Cochrane Deaerating Hot Process Softeners prepare make-up for the evaporators and are designed for lime and soda with supplementary phosphate, or for two-stage softening.

Feedwater heating is accomplished in six stages. The first three are direct contact heaters and the last three are closed heaters. The Cochrane Deaerators, as illustrated above, are used as the third stage of direct contact heating and deliver 913,000 lb. per hour with zero oxygen content. Steam from the ninth stage bleed point on the turbine is used in the deaerator.

A new publication on Cochrane Deaerators is just off the press. A copy will be sent on request.



Proportioning Pumps, Chemical Tanks, Filters and Sedimentation Tank of Cochrane Deaerating Hot Process Softener.



(Left) Cochrane Steam Sample Degasifier separates hydrogen from boiler outlet steam, for measuring dissociation of steam into hydrogen and oxygen.

Cochrane Corporation

3123 N. 17th ST. PHILADELPHIA, PA.

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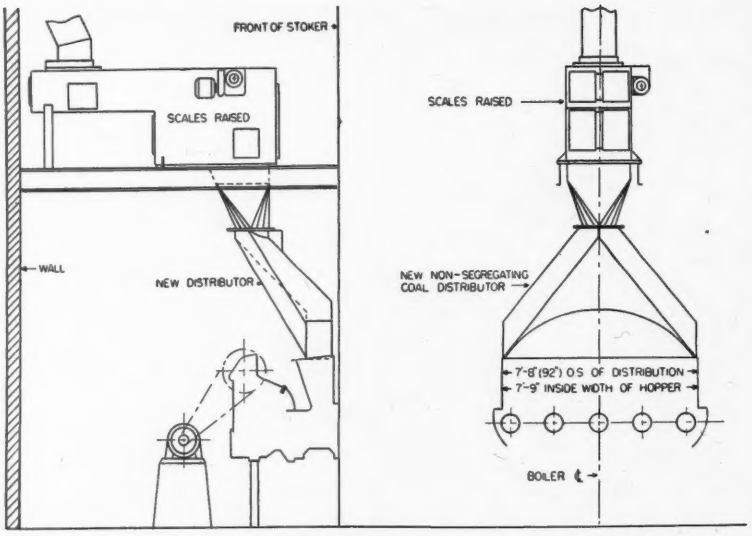


Fig. 2. The Second Prize Award solution suggests raising the coal scales to permit installation of a new distributor

WCXEW at top, WEBZW at left, EXYBE at right, and YZBY at bottom.

It may be necessary to reverse the scale hopper door pan so that it will discharge against the bottom of the distributor. This would reduce the free run-off of the coal which is sometimes disadvantageous. Scales of the types shown in the drawing are designed so that the lower section of the hopper can be disconnected and reversed easily without need of additional parts.

SECOND PRIZE AWARD
Gerald C. Dittman
Mechanical Engineer
Schmidt, Garden & Erikson
Chicago, Illinois

IF YOUR HERO in his travels visits very many plants he will find that one of the most common causes of stoker trouble and operation is due to coal segregation, as too often little thought is given this particular problem until it is too late.

Segregation as outlined in the problem cannot be corrected simply. Due to lack of headroom, baffles cannot possibly be used to eliminate the difficulty. Furthermore, baffles in a flat chute never correct segregation. A baffle may help to a small extent, but the best it can do is to correct a small portion of this difficulty. Installation of a cross screw conveyor might also prove unsatisfactory in this small space and might present a rather delicate mechanical problem of control.

It appears, however, that the best way to overcome the difficulty would be to install a conical non-segregating coal distributor between the coal scale and the stoker hopper. This device feeds the coal to the stoker hopper over a conical shaped plate instead of over a flat surface as shown in the problem. A cone having a vertical axis has all its elements at the same angle to the horizontal and all paths presented to the coal are alike, thereby assuring a uniform mixture to the stoker hopper.

In order to install such a distributor in the plant it would be necessary to raise the coal scale. The plant owners, however, might object to this because of the expense involved. However, it is not likely that the segregation problem can be overcome without going to such an arrangement.

The sketch shown in the problem indicates the scale hopper is fed from a chute which comes partly from the rear and partly from the side. This chute in itself may be responsible for some part of the coal segregation on the stoker which trouble would be eliminated by the installation of the non-segregating distributor.

Undoubtedly, the operators of the boiler in this plant are having considerable difficulty with their stoker operation. Maintenance of the outside retorts is probably high. The CO_2 across the boiler is undoubtedly stratified, it being higher in the center due to a more compact fuel bed and the combustible content of the ash is probably higher than it should be for a properly operating unit.

Another curse of coal segregation is that the capacity of the unit is usually somewhat limited on account of the contributing factors as outlined and I believe that if the operators will install a spout as suggested, all of their troubles will be eliminated.

Figure 2 shows in a general way how the installation would look if a non-segregating spout were installed.

THIRD PRIZE AWARD
Glenn Browning
Columbus, Ohio

AS THIS HERO fellow is the kind of a guy that will thumb his nose at the Japs, I am just obliged to do my best to help him. My solution is shown by Fig. 3. This is intended to distribute the coal in five uniform piles, one directly over each plunger or ram, by arranging 10 inverted V baffles and eight deflectors as shown, in such order that they will accomplish the desired result.

Baffles (1) and (2) are shown in the inset. They are hinged at the top at S, and the sides, or wings, are adjustable, as the backs of a book would be. At each end (attached to the round rod which forms the hinge pin) is a deflector (4) which will be described later. Baffles (3) are stationary combination baffles and deflectors while (5) are hinged at the top, and adjustable.

All baffles are parallel with the boiler. Adjusting rods (6) are of round material threaded on the end extending through the sides of the hopper and fitted with a nut. The fractions represent the percentage of the total coal which passes over that particular baffle or wing.

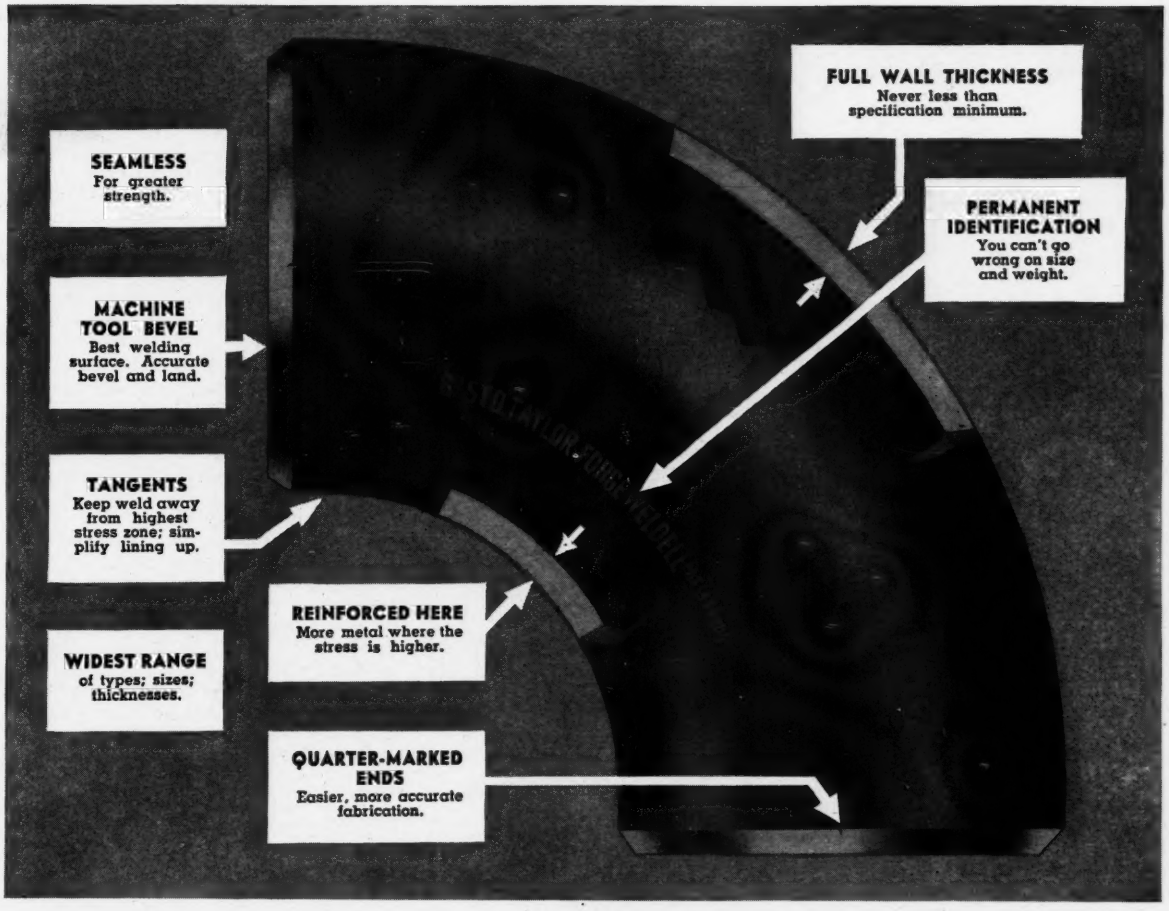
PROBLEM 22. A HOT SPOT IN THE ICE PLANT

WITH worrying about other people's problems Our Hero entirely overlooked one of his own, an important one too, for he promised the Boss last summer that he'd have it fixed over the winter. This is in connection with the ice plant which consists of: a 9 by 9 in. twin cylinder vertical compressor; one freezing tank with 240 standard 300 lb. cans (in the summer 96 cans are pulled every 24 hr. with a brine temperature of 16 deg. F.); a 15 by 25 ft. ice storage vault 8 ft. high; and a 6 by 8 ft. ante-room also 8 ft. high.

These rooms have 6 in. concrete floors, 4 in. of cork on the walls and 4 in. of cork on the inside of a cinder fill roof. These are cooled by pumping 30 g.p.m. of brine through 240 lineal ft. of 2 in. pipe. He wants to hold a temperature of 28 to 30 deg. F. in the vault but can never get lower than 32 deg. F. during the summer when the outside temperature is around 94 deg. F.

He has on hand a 3 by 3 in. twin compressor driven at 230 r.p.m. by a 5-hp. motor and could possibly dig up a bit more pipe in a pinch. He is a bit scotch on power, however, doesn't want to waste any and especially doesn't want to make some change which will mean a larger power bill all year when this is definitely a summer peak proposition. Also the Boss is a bit tight with money and Mr. Nelson of WPB is just as tight with materials.

Write your opinion of this case in a letter of not over 1000 words and send it to the contest editor by May 25. A first prize of $15 will be awarded for the best letter; a second prize of $10 and a third prize of $5. Entries in this problem contest should be addressed to the Contest Editor, Technical Publishing Co., 53 W. Jackson Blvd., Chicago, Ill.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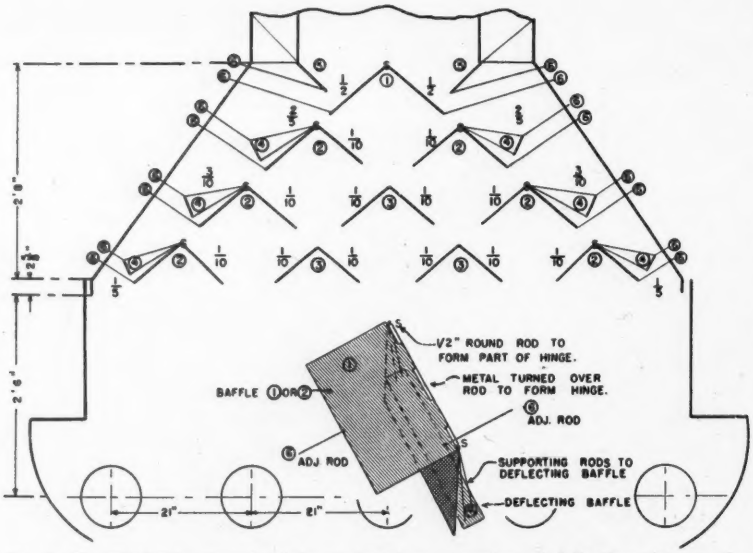


Fig. 3. The Third Prize Award solution is based on a number of deflecting plates in the present distributor with adjustable deflectors to be set as determined by conditions

Let's begin at the scale and start a pour of coal over this arrangement, and follow it through, dividing it in proper proportions, and controlling a uniform flow to its destination.

First we can see that baffle (5) prevents the coal from missing baffle (1), and also delivers in such a controlled form that there is a steady uniform flow off the lower part of baffle (1). Baffle (1) of course divides the coal in half and the lower edge is adjusted by adjusting rod (6) in such a position to cause the coal to fall, or pour to baffle (2) which in turn divides it in two parts, 1/10 taking the inward path, and 2/5 the outward.

While passing over this outward baffle, the larger sizes will gain momentum and will tumble and bounce outward away from the finer coal toward the sides of the hopper. If permitted, these lumps would continue this course all the way to the bottom, and pile up over each side plunger, the deflector (4) if properly proportioned and adjusted by rod (6) will, however, deflect this coal, back against the baffle (2) just as it is to leave the bottom edge, and cause it to be delivered in a steady uniform pour to the baffle below. As with baffle (1), if its wing is properly adjusted it will cause 1/10 of the pour to follow the inward course, and 3/10 the outer. This flow and control is continued over the remainder of the baffles below.

It is easy to visualize the course the coal follows over the inner baffles and see that each ram is supplied its proper share. It is evident if the coal is permitted to pile higher than the top of the bottom row of baffles this arrangement will no longer proportion the coal properly and I am of the opinion that no other arrangement can. This arrangement will reduce the hoppers' capacity about 35 per cent, but with automatic scales the coal supply can easily be regulated.

After installation and regulation, this arrangement should be practically free from maintenance, no motors or other means of power is required and this in itself is very desirable.

General Comment

Leslie Bradley of Bismarck, N. D., feels space is too limited to permit use of a non-segregating type distributor. Based on 3 yr. operation in his own plant with limited headroom and no segregation difficulties he suggests a complete change as follows:

"To remedy the trouble of coal segregation in the stoker hopper, I recommend that the present method of weighing be changed completely, but would try to adopt the present scale if possible, otherwise would buy a new one adapted to the needs of the new equipment.

"In Fig. 4 is shown a side view of the larry with scale run back under the coal chute for loading. After the scale hopper is full the scale carriage

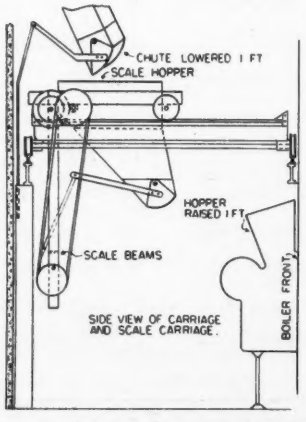


Fig. 4. Due to the limited room Mr. Bradley draws upon his own experience and suggests a weigh larry as a "sure fire method"

can be run towards the boiler so it will empty into the stoker hopper. The scale registering beams are located down near the floor so it can be easily adjusted to weigh each load.

"In this changeover it is suggested that the stoker hopper be built up 1 ft. to give more capacity and the coal chute from silo be lowered to suit conditions of the new scale hopper. The scale hopper is moved from the stoker hopper to coal chute by means of pulleys adapted for a rope or better, a ⅜ in. garden hose to run over a sprocket and a gear arrangement to move the carriage. If desired motor drive could be added to move the larry backward and forward and from side to side."

By far the majority of suggestions covered the use of baffles or deflectors in one form or another. J. D. Waid of Cincinnati, O., suggests reversing the scale pan to discharge away from the boiler and continues:

"In the coal hopper fasten a V-shape piece of metal across the center of the hopper from boiler front out with the point of the V upward. The wings of the V-shape metal can be tried and adjusted to make the coal fall near the outer ends of the hopper. This will let some coarse coal collect over the center retort, but it will be covered with the fines when the hopper is full and will mix as it is fed out."

A. H. Barnes of Leavenworth, Kan., has the same general idea, but would use more than one V if necessary.

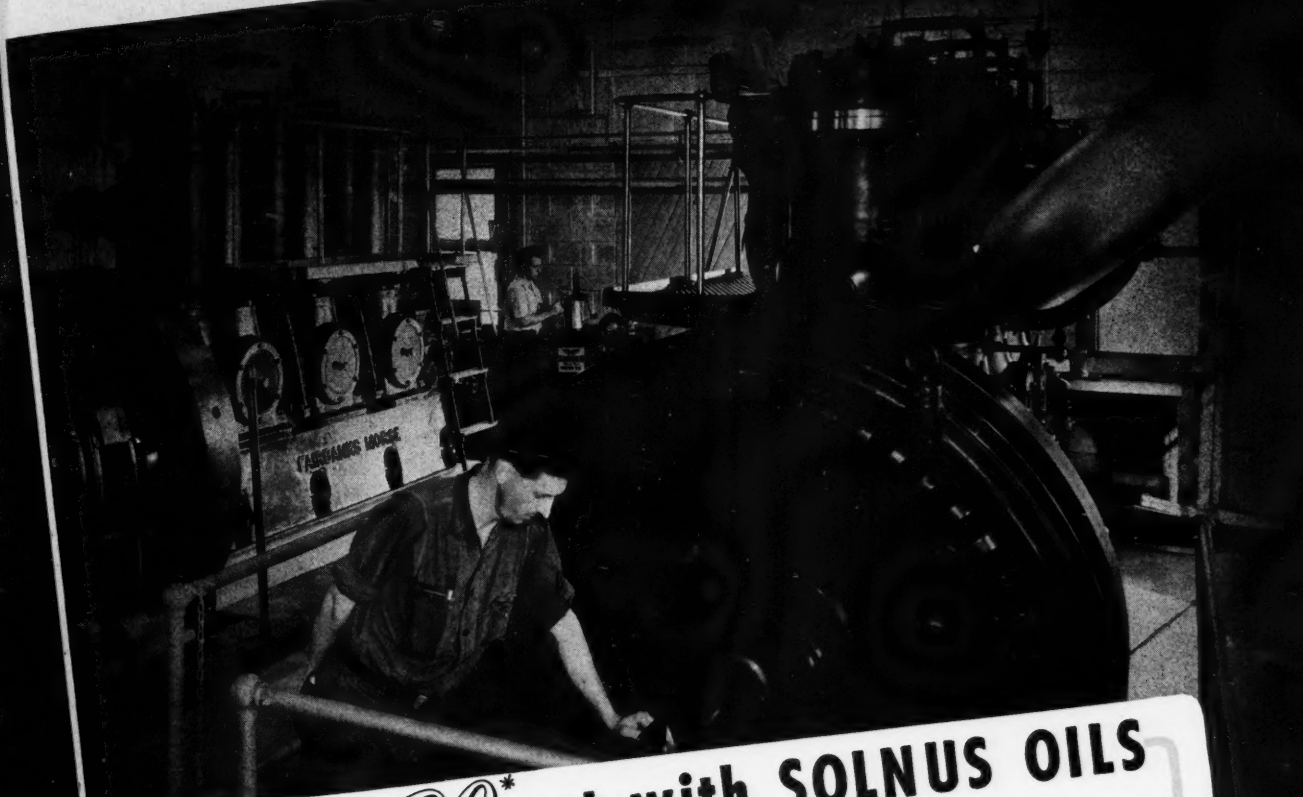
Leon Hawkinson of Sioux City, Ia., feels that "prepared stoker coal would be a permanent non-mechanical solution" but offers a mechanical solution based on the use of louvers and operating with the hopper coal level below these. He would use five of these louvers in two vertical rows, one row under each outside edge of the scale pan. The louvers would be 6 in. wide, ⅛ in. thick and set at an angle approximating the side angle of the distributor, i.e., about 60 deg.

An entirely different approach was offered by W. F. Schaphorst of Newark, N. J., by his suggestion that the distributor be rebuilt with a Venturi throat with the coal level maintained above the throat at all times so that it would always run full.

Possibility of at least a part of the segregation difficulty in the problem being the result of conditions ahead of the scales was pointed out by several including William T. Mullen of Philadelphia, Pa. In addition to changes in the distributor and scale pan, Mr. Mullen would provide a larger hopper on the scale with a swinging chute from the coal silo.

Oddly enough, perhaps because of the narrow width of the hopper, no entry gave serious consideration to screw conveyors split at the middle with right and left hand screws. These have been used effectively in a number of places, particularly on very wide boilers fired by several sprinkler stokers and where the head room is limited.

,002 HORSEPOWER HOURS PER GALLON



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War News From the Industrial Front

Only 100 More Tons of Copper for R.E.A.

ONLY 100 t. of additional copper will be allowed the R.E.A. to complete projects already underway. Last December the SPAB authorized allotment to the R.E.A. of 1500 t. of copper per month up to a total of 10,500 t. to be used with few exceptions, on projects 40 per cent complete on December 5.

R.E.A. reserved only 7200 t., but the copper situation is now so acute that WPB decided the final 3300 t. cannot be allotted for that purpose. To make possible the completion of 34 projects, WPB decided that the R.E.A. divert 550 t. from projects not yet started and allotted an additional 100 t. to make up the 650 t. required.

Silver for Busbars

TREASURY DEPARTMENT officials are reported working on an arrangement to lend unmonetized silver for use as busbars in plants being constructed for the Defense Plant Corp. Some 40,000 t. of silver are said to be involved; of this 13,000 t. will be used for new aluminum plants.

For this use 1.2 lb. of silver will replace 1 lb. of copper, and in connection with the 20 aluminum pot rooms now being built the silver would release nearly 11,000 t. of copper for other uses. Under the plan contemplated, the silver used in busbars and other heavy electrical equipment would be replaced as practical and the silver returned to the Treasury. Altogether the government owns some 86,000 t. of silver, about half of which is monetized.

Navy Takes R.E.A. Units

Two 4000-kw. generator units together with boilers and auxiliary equipment for a power co-operative near Genoa, Wis., were seized by the Navy for war purposes after the Northern States Power Co. advised the department that their company would supply the co-op with power at wholesale.

Utilities Given Higher Rating on Maintenance

REVISION of Preference Rating Order P46 (forecast last issue p. 112) increases the rating from A-10 to A-2 and A-5 for repair, maintenance and operating material for utility companies. An A-2 rating is granted to deliveries of material for maintenance, repair and operating supplies for power plants and pumping plants. An A-5 rating is granted for all other facilities, such as lines, pipes and substations.

One of the reasons for the distinction is that if a power plant or a pumping station breaks down, the whole system is put out of business. If a power line or a water pipe breaks, only a part of the system is affected. In either case, the rating is high enough to make possible prompt repair.

The order also assigns a rating of A-5 to deliveries of materials to bring electricity, gas, or water to war plants or other projects—bearing a rating of A-5 or better. This does not apply to housing projects. An A-5 rating is also granted to deliveries of materials needed to protect power or water plants against sabotage such as fencing, tear gas bombs for guards around such plants, etc. These ratings may not be applied without prior authorization from the Director of Industry Operations of the War Production Board.

Line extensions to serve a new consumer are restricted to 250 ft. instead of 1000 ft. permitted by the original order, although extensions begun prior to March 26 may be completed. Also houses that were wired prior to March 26 or for which the foundations were completed by that date, may be served with electricity provided they are not more than 2000 ft. from an existing line and provided the utility specifies that galvanized steel wire will be used instead of copper.

This policy will also permit extension of service to a number of homes which were already wired when the 1000 ft. extension limit was imposed last December. These extensions are not automatically approved, however, and authorization must be obtained or each extension over 250 ft.

Two other changes in the order give utilities greater flexibility in obtaining delivery of materials. Under the previous order restrictions were placed on the acceptance of deliveries of material in any quarterly calendar period. Often through no fault of the utility such materials were not delivered on the dates for which they were ordered.

This provision has been changed to place the restriction not on the period in which materials are delivered but on the period in which they are scheduled for delivery. Previously a utility could not obtain certain items which it needed if the dollar value of the items on hand within the same class exceeded a practical working inventory. This has been changed to permit a limited amount of deliveries of needed items.

WPB Reserves Rapeseed Oil for Marine Engines

TO CONSERVE the supply and direct the distribution of rapeseed oil, WPB issued General Preference Order M-77 reserving rapeseed supplies for war needs.

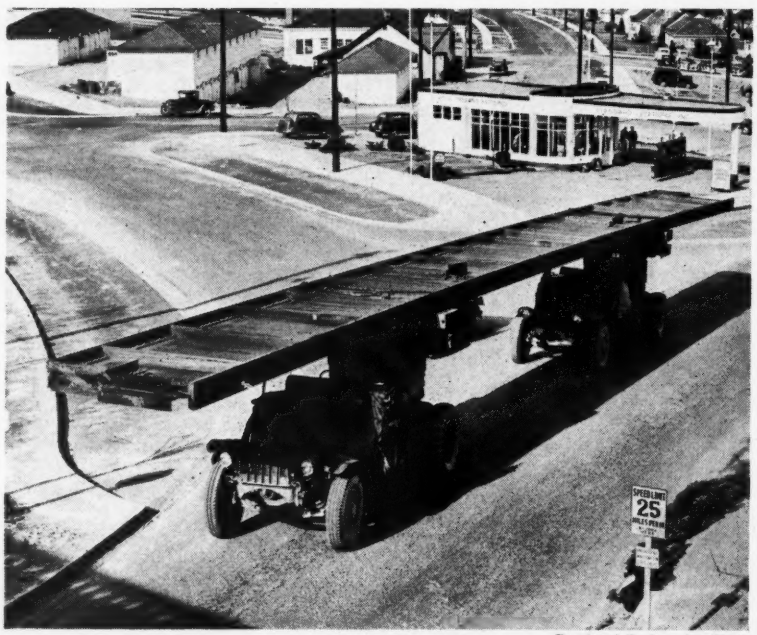
The order provides that after April 1 rapeseed oil can be used only for the manufacture of marine engine oils, heavy machine lubricating oils, pneumatic tool oils, blown rapeseed oil, and elastic solids for compounding rubber, unless specific authorization for other uses is given by the Director of Industry Operations.

Fluorescent Lighting Fixture Production Halted

WPB on APRIL 2 ordered an immediate end to the production of fluorescent lighting fixtures except for use of existing inventories for a period of 20 days and certain other excepted purposes.

This (Limitation Order L-78) is expected to result in the saving of 35,000 t. of steel, 2200 t. of copper, and 5200 lb. of mercury.

Terms of the order prohibit the manufacture or assembly of any fluorescent lighting fixture or part, not-



Bureau of Reclamation Photo.

No! They are not afraid of Japs—they just don't like them and are demonstrating a bit of plain and fancy team work to get girders down to a Pacific Coast shipyard. The girders, 100 ft. long and 8 ft. high, weigh 37 t. and are being removed from the downstream side of Grand Coulee Dam—part of a construction trestle no longer needed

Crowding the turns can mean trouble in piping, too!

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withstanding existing contracts or agreements, except on orders bearing a preference rating of A-2 or better.

There are approximately 2000 companies which produce fluorescent lighting units and parts. Because of the relative youth of the industry, accurate data is not available on recent production and sales. It is estimated by the WPB Building Materials Branch, however, that the dollar volume in 1942, on an unrestricted basis, would have been about $100,000,000, representing 10,000,000 units.

Nazi Propaganda Disclosed in Pamphlet

FIFTEEN Nazi propaganda objectives in the United States are disclosed in a documented pamphlet, entitled "Divide and Conquer." The pamphlet describes German propaganda methods in continental Europe and warns that the United States is now being subjected to a "total barrage of the Nazi strategy of terror." Copies may be obtained by writing to the Office of Facts and Figures, Washington, D. C.

1600 Minor Priority Violations

THE OPERATIONS of 3500 firms have been surveyed for priorities violations by the compliance branch of the War Production Board since it was set up last June, L. J. Martin, assistant chief of the Bureau of Priorities, announced April 5. The operations of 10,500 additional companies are now being investigated, and reviews of the work of 7100 companies are now being prepared, the branch reported.

Of the 3500 completed reports received by the branch, more than 1600 revealed no violations, largely through misunderstanding. These received letters explaining priority regulations.

A small number of the reports indicate violations of varying degrees of seriousness. These reports are now being studied, and punitive action will probably be recommended in the case of the more serious examples.

All Copper Screen Frozen

ALL STOCKS of copper screening in the United States, including uncut rolls in the hands of retailers, were frozen April 9 by an amendment to Copper Order M-9-c issued by the Director of Industry Operations.

Manufacture of copper screening was stopped on March 31. Large stocks exist in the country in the hands of manufacturers, wholesalers, and retailers that can be used by the Military Services, thus avoiding the use of additional copper to make new screening for them.

Adequate amounts of steel wire screening are available for civilian use.

The amended order provides no person shall deliver, install or cut any copper screening except for certain Government agencies or upon specific permission of the Director of Industry Operations. It does not apply to used or second-hand screening or to rolls which were partly used on April 9.

Hard Coal Price Halted at Existing Level

POSSIBILITY of higher producers' prices for Pennsylvania anthracite was removed March 31 by the OPA with the issuance of Maximum Price Regulation No. 112, which keeps hard coal prices at the mine at existing levels and orders customary seasonal discounts on domestic sizes, beginning with 50 ct. per net ton to 10 ct. during July.

Under the price regulation the following maximum prices are established for anthracite f.o.b. transportation facilities at the mine or preparation plant from which delivery is made:

Size:	
Domestic:	
Broken, egg, stove, and chestnut	$6.75
Pea	5.25
Steam:	
No. 1 Buckwheat	3.75
Rice (No. 2 Buckwheat)	2.90
Barley (No. 3 Buckwheat)	2.15

WPB Stops Nonessential Construction

THE WAR PRODUCTION BOARD on April 9 called a halt to nonessential construction. Effective immediately, Conservation Order L-41 prohibits the start of unauthorized construction projects which use material and construction equipment needed in the war effort. It also places all new publicly and privately financed construction under rigid control, except for certain strictly limited categories.

Action was taken by the WPB because the war requirements of the United States have created a shortage of materials for war production and construction. It is in the national interest, the Board stated, that all construction which is not essential, directly or indirectly, to the successful prosecution of the war, and which involves the use of labor, material or equipment urgently needed in the war effort, be deferred for the duration of the emergency.

78,000 Lb. of Copper Seized

TWO LOTS of copper sheet, totaling 78,000 pounds, the property of J. M. Katz, 261 Broadway, New York, N. Y., were seized April 6 for war purposes at Allentown, Pa., and Peru, Ill., by order of the inventory and requisitioning branch. Mr. Katz, who had previously refused an offer by Metals Reserve Corporation to purchase this copper, is a supplier of bathroom accessories. The material taken over represents inventories, in excess of requirements to fill rated orders, which he could not otherwise dispose of because of the terms of the copper conservation order.

Canadian Power May Be Limited

SOME CURTAILMENT of nonwar uses of electric power may be necessary in Canada late in 1942 as a result of war industries being established there, William L. Batt, chairman, U. S.-Canada Materials Coordinating Committee, announced April 10 after a conference with Canadian officials.

Such a curtailment would affect United States supplies of newsprint, as this industry is one of Canada's largest users of electric power. The time or extent of this possible curtailment, however, is uncertain.

The ruling factor will be waterfall in Canada. Low water may bring drastic curtailment, and plenty of water would reduce it to a minimum.

Aluminum and chemical plants now projected for Canada, at the request of the United States, will take the bulk of the Dominion's available power.

Westinghouse Photo.

Quien Es? These gentlemen are representatives of South and Central America utilities, touring North American industries to study American practices. With headquarters in the R. E. A., Washington, D. C., delegates represent Argentina, Chile, Colombia, Guatemala, Honduras, Mexico, Peru and Uruguay. The above picture was taken at the Westinghouse Meter Div., Newark, N. J.

- General Motors Corporation
- Copperweld Steel Company
- American Gas & Electric Company
- Eaton Manufacturing Company
- Norton & Company
- E. I. DuPont de Nemours & Co., Inc.
- Defense Plant Corp., Corry, Pa.
- Timken Roller Bearing Company
- United States War Department
- Cooper-Bessemer Corporation
- Southern Railway Company
- United States Housing Authority
- The Weatherhead Company
- Chicago, Rock Island & Pacific Ry.
- Black & Decker Electric Company
- United Milk Products Company
- Standard Brands, Inc.
- Taylor-Winfield Corporation
- Electric Controller & Mfg. Co.
- Ferro Enamel Corporation
- United States Steel Corporation
- General Hosiery Company
- Board of Education, Pittsburgh, Pa.
- Food Machinery Corp.— Peerless Pump Div.
- American Fork & Hoe Company
- General Fire Extinguisher Company
- Taylorcraft Aviation Corporation
- Hercules Motors Corporation

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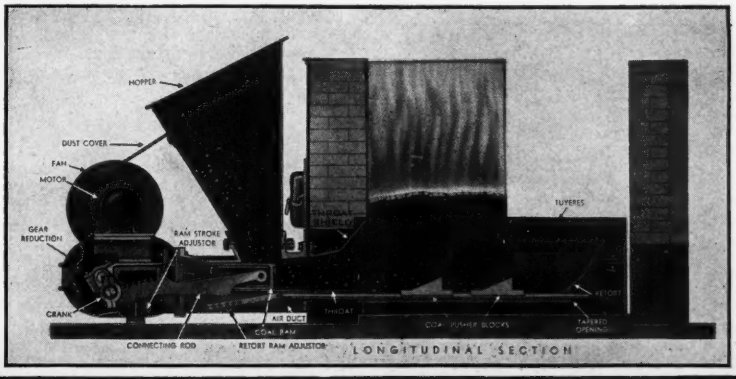

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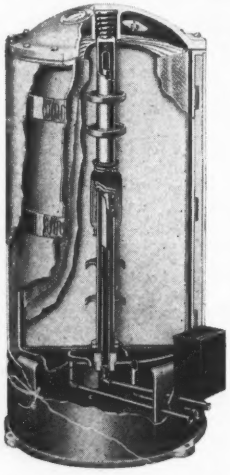
Information that you desire about any equipment will be gladly furnished without obligation. WRITE POWER PLANT ENGINEERING.

Continuous Oil Purifier

ONE OF THE recent developments in the field of lubrication is the continuous oil purifier manufactured by The Honan-Crane Corp., Lebanon, Ind., which is designed to remove abrasives, sludge, varnishes and acids and thus restore oil to its original lubricating efficiency. It is being applied in industry for purifying such oils as those used to lubricate engines, turbines, generators and compressors, also fuel oils, insulating oils and oils used for transmitting pressures.



In operation dirty oil enters the purifier through the inlet pipe at the bottom, is pumped into the body of the refiner where it completely surrounds the refining mass of Cranite which is confined within a perforated basket and filter cloth. Purification takes place as the oil is forced through this mass of Cranite on its course to the outlet at the center of the refining chamber.

To reach the outlet the purified oil must pass through layers of dense wool felt and a fine mesh screen, rise to the top of the center pipe then pass down through the center pipe from which it is delivered to the supply sump.

Shatter-Resistant Coating for Glass

AIR RAID precautions emphasize the need of a transparent material for application on glass to prevent shattering. This need is met by the new transparent coating developed by The Wilbur and Williams Co., Boston, Mass.

This new material comes in liquid form, ready for use. It can be applied by spraying or brushing; for small areas excellent results can be obtained with an ordinary Flit-gun; for larger areas regular spray equipment is desirable.

It dries very quickly, forming a strong, tough film having a tensile strength of from 3000 to 5000 lb. per sq. in. Elongation is over 20 per cent, permitting considerable movement of the glass without rupture of the film. This coating passes sunlight with little absorption and weathers well without discoloration.

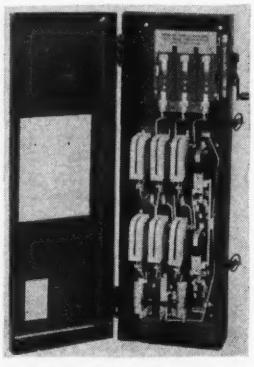
The actual melting-point is over 200 deg. C., and excellent protection is given at temperatures up to 212 deg. F. (boiling point of water). Only very slight discoloration will be found after prolonged exposure. While not intended for long service on the exterior, where exposed to weather, this shatter-resistant coating should be very useful in any period of active bombing; and, on the interior should give protection for an indefinite period. It can be washed whenever necessary.

Factories which require window-glass paint in normal times for glare-reduction, may now obtain a colored coating which combines glare-reduction with resistance to shattering.

Combination Magnetic Reversing Starters

A NEW LINE of alternating-current combination magnetic reversing starters for full-voltage starting and reversing of squirrel-cage induction motors has been recently announced by the General Electric Co., Schenectady, N. Y. Suitable for the primary control of wound-rotor motors, these single-unit starters consist of two mechanically interlocked reversing contactors, a two-pole overload relay, with a circuit breaker or a fusible or nonfusible motor-circuit switch.

The starters, designed to provide full-



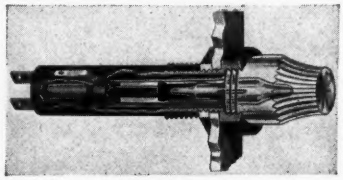
voltage reversing control and short-circuit protection in one unit, are said to save space and installation time and provide greater protection for equipment and operators. They are completely wired and ready to operate after connection of incoming power lines, outgoing motor lines, and control circuit. The line includes NEMA size 0 to 4 starters covering single-phase and 3-phase motors in sizes up to and including 100 hp. to 440 or 550 v.

The fusible forms combine a manually operated motor circuit switch with clips for cartridge-type fuses. Under short-circuit conditions, the fuses provide fast interruption of circuits having maximum available current of 10,000 amp. at rated voltage.

The circuit breaker forms provide simultaneous tripping of all phases on short circuits, and have a trip-free mechanism which prevents holding the breaker closed under short-circuit conditions. The breaker can be reset after operation by returning the operating handle to the off position. An isothermic temperature overload relay protects the motor from dangerous overheating caused by overloads or other conditions. The starters are available in Type 1 general-purpose enclosures, Type 1A semi-dust-tight enclosures, Type 5 dust-tight enclosures, or Type 4 water-tight enclosures.

Broken Circuit Indicator

A NEW PANEL mounting indicator, said to be capable of locating breaks in circuits instantly has been announced by Littelfuse, Inc., 4757 Ravenswood Ave., Chicago, Ill.



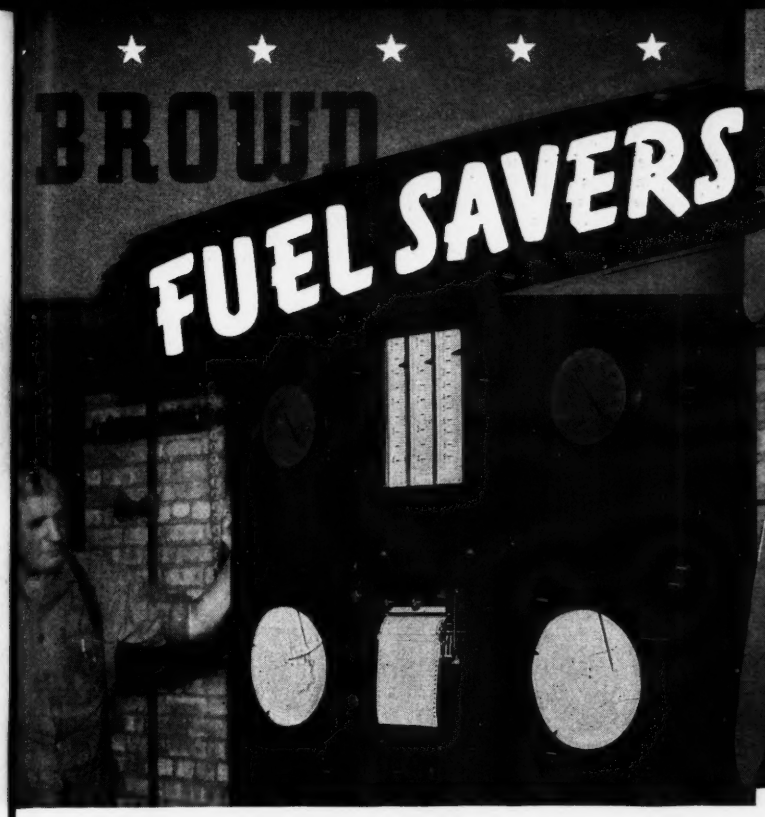
The indicator may be installed at any convenient or desirable point in connection with remote motor control, and has a bulb attachment which glows on currents as low as 100 microamperes and clearly indicates an opened circuit breaker. It can be had for 24 or 48 v. filament bulb, for use without a resistor; otherwise it uses a build-in 200,000 ohm protective resistor, in series with a neon lamp. The resistor prevents the lamp from blowing out on unexpected high voltages.

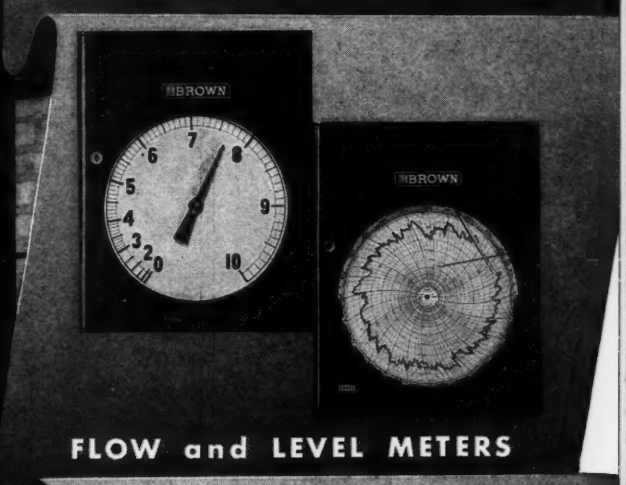
The indicator is made for panels up to 5/16 in. thick and ½ in. diam. mounting hole and has a rating of 90 to 250 v. Overall length is 2 in. below the panel, ⅛ in. above.

M T D Calculator

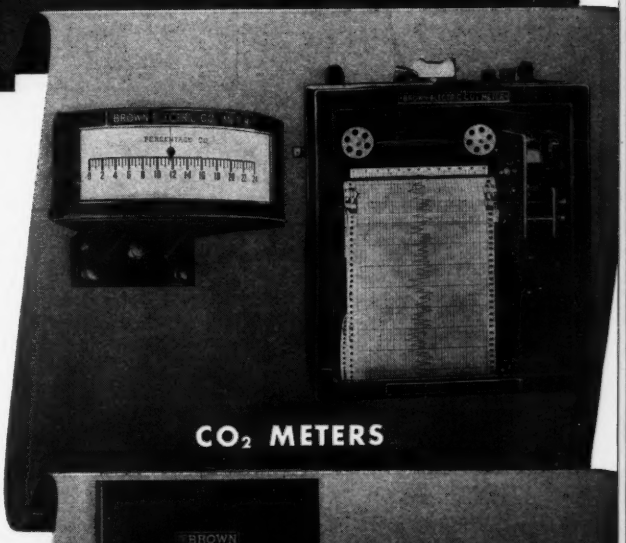
TO HELP engineers in the solution of approximating the heat transfer surfaces to be used in heat exchange equipment, the American Locomotive Co., 30 Church St., New York City, has devised a calculator in the form of a special cardboard slide rule. The calculator includes scales for the calculation of the logarithmic mean-temperature-difference, as well as the m.t.d. correction factors for one, two, three, four and six shell passes, and also the C and D scales of the conventional slide rule.

BROWN FUEL SAVERS for BOILER ROOMS

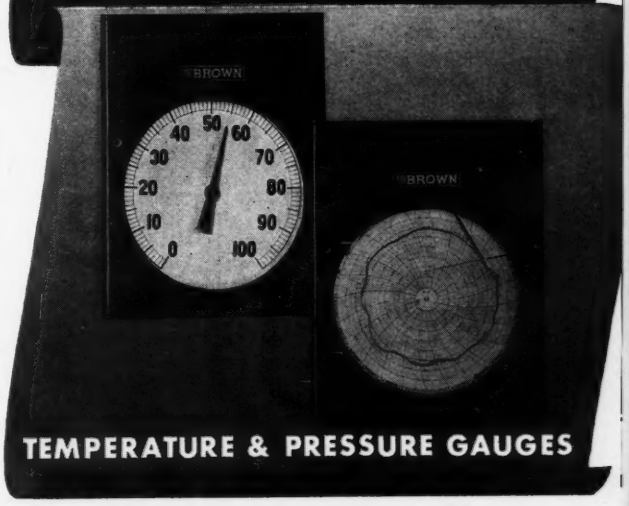




FLOW and LEVEL METERS



CO_2 METERS



TEMPERATURE & PRESSURE GAUGES

IF you use steam for power, heating or processing—do you know how much steam is generated for every dollar expended for fuel? Are your boilers operating at their highest efficiency? How economically is steam being used?

To get the answers to these questions it is essential to measure temperatures, pressures, flows, per cent CO_2 and liquid levels.

Whether you burn oil, gas or coal, Brown Indicating and Recording Instruments furnish the essential information to operators and engineers to enable them to reduce fuel costs. For example:

BROWN FLOW METERS . . . tell how much steam is generated by each boiler; the amount of water fed to the boilers, and the rate and quantity of blow-down.

BROWN CO_2 METERS . . . when used as a firing guide, enable operators to hold the correct per cent CO_2 and prevent fuel losses due to improper air-fuel ratios.

BROWN THERMOMETERS AND PYROMETERS . . . are essential guides in checking Flue Gas, Feed Water, Economizer and Superheater temperatures. They are vital factors in overall operating efficiency.

BROWN PRESSURE GAUGES . . . aid in maintaining steam pressures, not only in the boiler, but also in each department.

Our engineers will be glad to recommend the instruments that will most economically meet your boiler room or plant requirements. Write for information.

For Temperatures . . . . . Pressures . . . . . Flows . . . . . Liquid Levels

BROWN INSTRUMENTS

ELECTRIC • AIR OPERATED

THE BROWN INSTRUMENT COMPANY, 4491 WAYNE AVENUE, PHILADELPHIA, PENNSYLVANIA

DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR CO.

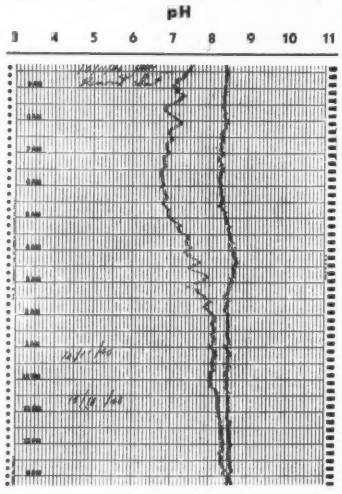
MINNEAPOLIS, MINNESOTA, AND 119 PETER STREET, TORONTO, CANADA

Wadsworth Road, Perivale, Middlesex, England: Nybrokajen 7, Stockholm, Sweden

pH Recorder

SIMULTANEOUS records of pH at separate and independent points in a fluid-flow system can now be utilized to provide a continuous "before and after" picture of pH that enables the operator to see continuously the effectiveness of the process or treatment in use and accordingly, guides him to attain best results. This advancemnt comes as a result of research work carried out by the Cambridge Instrument Co., Inc., Grand Central Terminal, New York, N. Y.

An actual record is reproduced here from the condensate system of a large utility generating plant, where such guidance has helped to solve the important problem of turbine blade deposits. The new instrument which provides these records incorporates an outstanding advance in circuit design that permits installation of the measuring electrodes at separate and independent sampling points in the plant. They are connected electrically to the recorder which may be a considerable distance away.

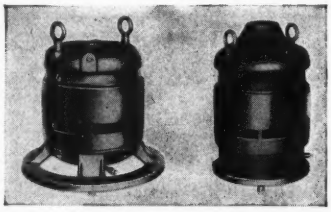


The first application of the new multi-point pH Recorder was made in the power plant field, where corrosion of boiler systems is largely influenced by the pH of the feedwater. Municipal water purification and treatment, and sewage disposal are also processes that require the maintenance of definite pH values at various stages to secure optimum results. The operations in which multipoint pH recordings may prove of value are numerous and varied, including any industrial process the success of which depends upon changes in pH values.

New Tri-Clad Motors

THREE new motors—a vertical general-purpose polyphase motor, a vertical shielded polyphase motor (1 to 20 hp.) and a vertical shielded single-phase motor (1 to 5 hp.) have been added to the General Electric Tri-Clad motors. The shielded-type motors are especially suited to pumping applications, and the general-purpose motor is suitable for use in the machine tool industry as well as for agitators, mixers, and similar applications.

The compact, cast-iron frame and cover of the general purpose motors are designed to give added protection to electrical parts, without adding materially to the over-all height. The use of Formex wire, new punchings and coil shapes, double-end ventilation, and balanced design are features said to contribute to long life. All openings are shielded to bar the entrance of chips or other falling objects.

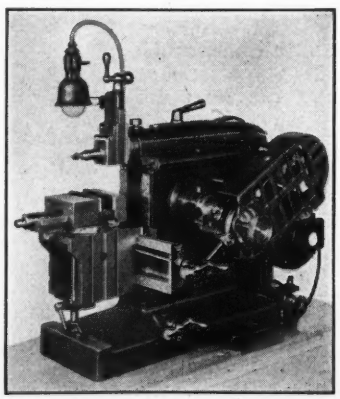


The polyphase shielded-type motors are available in either solid-shaft or hollow-shaft construction, while the single-phase shielded-type motors are available only in solid-shaft construction. Both shielded types are for normal-thrust or high-thrust applications. The cover is contoured to deflect dripping liquids and falling objects. All openings in the stator frame and end shields are protected against the entrance of splashing liquids. Air is discharged downward to low velocity, thus permitting little or no dust disturbance around the motor.

These motors are suitable for outdoor operation except where extremes of moisture, dust, or other harmful agents made the selection of fan-cooled motors more economical. All frame sizes have common mounting dimensions. The motors can be rotated to any one of four base positions without modification of the supporting structure.

Precision Shaper

A NEW precision shaper, the 7 in. Ammco, has been announced recently by the Automotive Maintenance Machinery Co., 2100 Commonwealth Ave., North Chicago, Ill.

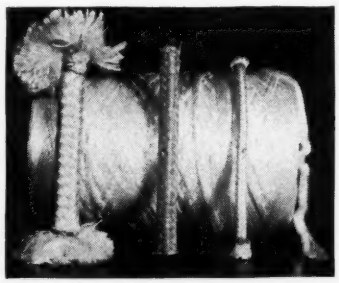


The shaper is available for stationary installation or can be mounted on a portable cabinet. Construction features include adjustable tool head which can be graduated from 0 to 9 deg. for angle work, semi-steel vise, with steel insert plates for the vise jaws, reversible and adjustable feed mechanism which varies from .003 to .018 in. and the countershaft is equipped with a 4 step V-pulley with separate adjustment for V-belt and motor belt. Pulleys and belt are enclosed behind a hinge-type safety belt guard for quick change of belt, also the ways of the ram, tool head and front face of the main frame are of the V type.

New Rayon Packing

RAYON TOW for use in braided mechanical packing for marine and industrial machinery has been developed by the Rayon Div. of E. I. du Pont de Nemours & Co., Wilmington, Del. It was designed to serve in place of European flax, which has become scarce and expensive because of wartime shipping difficulties.

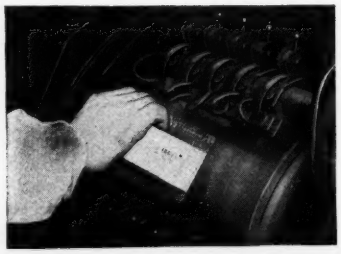
The tow is manufactured in a continuous length and consists of several thousand filaments or fibers. It is wound on tubes in 8 lb. packages and can be used on braiding equipment formerly employed in braiding flax packing. The finished square-braided packing is marketed in long lengths and may be cut to any desired length for shaping into rings or coils and installing in stuffing boxes. The rayon fiber is said to hold up well under pressures up to more than 4000 lb. per sq. in.



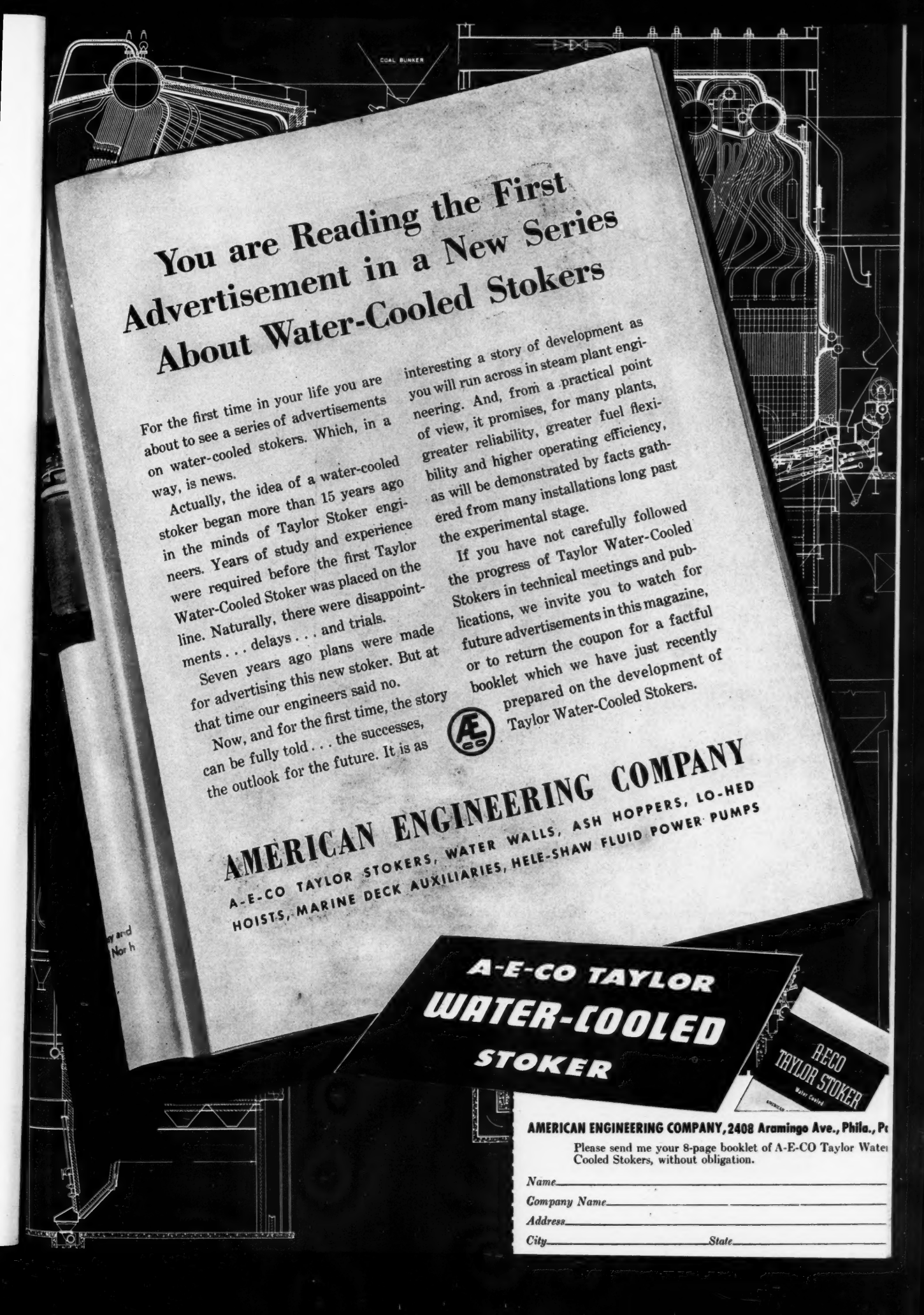
This braided rayon packing is impregnated with any one of a variety of semi-solid fats, oils or waxes by processes usually employed in the case of flax packing. In some varieties the packing or the individual strands are dusted with graphite. The rayon packing swells slightly more than flax when in contact with water and this tendency is allowed for braiding the rayon packing slightly less firmly and in slightly smaller calibre than the flax packing.

Commutator Cleaning Stone

EXCESS FILM and dirt which accumulates on commutators through heavy and continuous power loads is said to be quickly and easily removed by a new cleaning stone announced by the Ideal Commutator Dresser Co., Sycamore, Ill.



The stone, which cleans while the motor or generator is running, is used by holding it against the commutator and slowly moving across the face. The stone is said to be capable of cleaning film from the brush seats, help reseat the brushes, improve brush performances, reduce noise, even distribution of brush contact drop and brush wear and reduce, chattering and sparking.



You are Reading the First Advertisement in a New Series About Water-Cooled Stokers

For the first time in your life you are about to see a series of advertisements on water-cooled stokers. Which, in a way, is news.

Actually, the idea of a water-cooled stoker began more than 15 years ago in the minds of Taylor Stoker engineers. Years of study and experience were required before the first Taylor Water-Cooled Stoker was placed on the line. Naturally, there were disappointments . . . delays . . . and trials.

Seven years ago plans were made for advertising this new stoker. But at that time our engineers said no.

Now, and for the first time, the story can be fully told . . . the successes, the outlook for the future. It is as interesting a story of development as you will run across in steam plant engineering. And, from a practical point of view, it promises, for many plants, greater reliability, greater fuel flexibility and higher operating efficiency, as will be demonstrated by facts gathered from many installations long past the experimental stage.

If you have not carefully followed the progress of Taylor Water-Cooled Stokers in technical meetings and publications, we invite you to watch for future advertisements in this magazine, or to return the coupon for a factful booklet which we have just recently prepared on the development of Taylor Water-Cooled Stokers.

AMERICAN ENGINEERING COMPANY

A-E-CO TAYLOR STOKERS, WATER WALLS, ASH HOPPERS, LO-HED HOISTS, MARINE DECK AUXILIARIES, HELE-SHAW FLUID POWER PUMPS

A-E-CO TAYLOR
WATER-COOLED
STOKER

A-E-CO TAYLOR STOKER
Water Cooled

AMERICAN ENGINEERING COMPANY, 2408 Aramingo Ave., Phila., Pa

Please send me your 8-page booklet of A-E-CO Taylor Water Cooled Stokers, without obligation.

*Name*_____

*Company Name*_____

*Address*_____

*City*_____ *State*_____

You can measure speeds by TOUCH with a "FRAHM" TACHOMETER

Simply hold the Frahm Tachometer against some stationary part of a motor, turbine, centrifuge or any such machine and almost immediately one of a series of calibrated reeds begins to vibrate, and the corresponding point on the scale shows the speed.

This unique tachometer can be used to measure speed of any single rotating element, large or small, open or totally enclosed, and is equally accurate for measuring vibration frequencies. It has no pointer and no wearing parts and its factory-set calibration cannot be lost through over-speeding or lack of oil. Having no belts, gears, or electrical connections, its use imposes no load on the machine under test. Made in types for hand use and for permanent mounting in ranges from 900 up to 30,000 r.p.m. or v.p.m.

★

Write for Bulletin 1590-PE which describes Frahm Tachometers of both the portable and permanently mounted types.

James G. Biddle Co.

1211-13 ARCH STREET *Electrical and Scientific Instruments* PHILADELPHIA, PA.

Instrument for Measuring Bolt Torque

THE TORQOMETER, a new precision instrument used for measuring bolt torque and announced recently by Snap-On Tools Corp., Kenosha, Wis., is said to be free from any inherent friction, can be pre-set to any torque load and used to set a series of bolts to an equalized, predetermined tension or torque and also aid in eliminating mechanical distortion caused by unevenly tensioned nuts and bolts.

The tool has no springs and the entire torque measuring action and dial mechanism is built as a complete unit and set in a streamline case and handle. The tool is also equipped with a flashlight signal, especially useful where lighting conditions make it difficult to read the dial and also as a signal to show when the desired tension or bolt torque has been reached. The torqometer is available in seven sizes with capacities ranging from 0 to 1500 ft. lb.

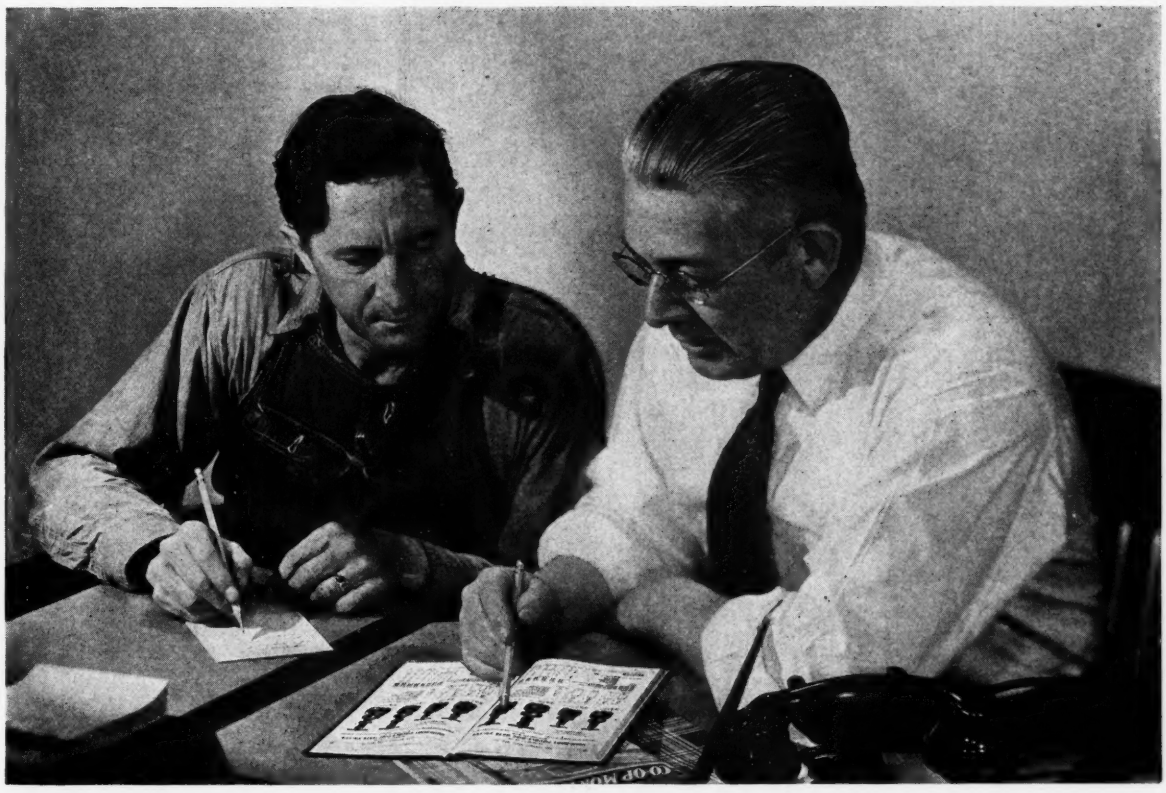
Vacuum Cleaner

TWENTY-FOUR HOUR operation is feasible with the new Tornado Model 117 Hi-cycle vacuum cleaner developed by the Breuer Electric Mfg. Co., 5100 N. Ravenswood Ave., Chicago, Ill. This unit is light in weight and portable, runs at high speed and is especially suited for continuous, heavy duty cleaning, made possible by the absence of commutator or carbon brushes.

Suction strength has been increased in this new cleaner by employing a higher rate of speed which makes possible the picking up of such heavy material as welding flux, scrap, heavy particles of dust and dirt, water and other materials or debris, the removal of which requires unusual power. The Hi-cycle motor is made to operate on 220 v., 180 cycle current only.

Expansion Loops

EXPANSION loops for any system and to any specification, as to kind of pipe, size, or number of pipes required; or type of insulation desired, etc., are now available, subject to government regulation, from the Ric-wiL Co., 1562 Union Commerce Bldg., Cleveland, Ohio. Loops



A MEMO FOR THE YEAR 1 A.V.*

We must acknowledge the fact that during the present emergency it is difficult, if not impossible, to obtain equipment and supplies for any but war projects. However, the present situation will not last, and far-sighted plant managers and engineers are already planning for "The Year 1 A.V.*"

What do these plans include? Necessary replacements of equipment that is now being worn out at a rapid rate . . . readjustments to take care of regular commercial business that is now being subordinated to war requirements . . . expansions that may be required for new developments.

"In time of war, prepare for peace" . . . and those who plan now will be in the best position for necessary readjustments without loss of time. Kennedy can help you decide on the most suitable types of valves for any projected requirements of service, fluid, pressure and temperature. The authoritative advice of the Kennedy engineers is yours without charge or obligation. Why not start now to prepare for "The Year 1 A.V.*"

*"The Year 1 A.V."? To American industry it means "AFTER VICTORY"

THE KENNEDY VALVE MFG. CO.
ELMIRA • NEW YORK

KENNEDY *valves . . . pipe fittings . . . fire hydrants*

INSTALLED

RESULT: 9 ADDITIONAL FULLERS INSTALLED

Fuller Rotaries are built for capacities to 1800 C. F. M. actual free-air delivery, pressures to 125-lb.

"COMPRESSED AIR IN INDUSTRY"
Contest
NOW STREAMLINED FOR WAR
PRIZES DOUBLED—NOW
$1000.00
Closing Date Extended To
July 1st, 1942
ENTER! THERE IS STILL TIME
RULES FREE—WRITE EDUCATIONAL DIRECTOR
Compressed Air Institute
EAST ORANGE, N. J.

Exceptionally low operating cost, resulting in all-around satisfactory performance of the initial installation, has resulted in the purchase of nine additional Fuller Rotary Compressors by a large eastern steel company. Following installation of this first unit, when compressed air demands increased, more Fullers were installed to best advantage.

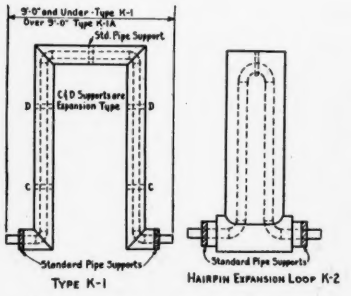
This is not an exceptional case . . . many companies have found it pays to practically standardize on Fullers. If you haven't become acquainted with the possibilities of Fullers, *why not do it now?*

FULLER COMPANY
CATASAUQUA, PENNSYLVANIA
Chicago: 1118 Marquette Bldg.
San Francisco: 320-321 Chancery Bldg.

C-56

FULLER
PIONEERS OF HIGH-EFFICIENCY ROTARY COMPRESSORS

are furnished completely prefabricated and factory sealed, and are available for underground or overhead service for lines inside or outside of buildings. These expansion loops are precision-made under controlled factory conditions and shipped to the job ready to install.

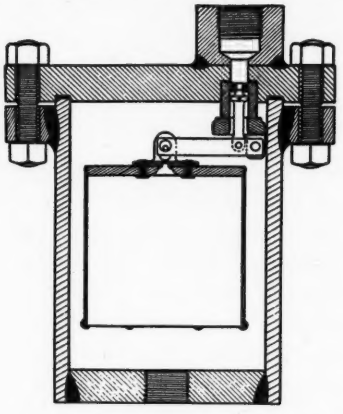


TYPE K-1 HAIRPIN EXPANSION LOOP K-2

The loops can be fabricated in a choice of several types other than K-1 and K-2 which are illustrated. They are available with the proper kind of pipe for steam and return or condensate, hot water, oil or combinations of any of these, as specified.

High-Pressure Trap

FOR DRAINING lines up to 600 lb. pressure and 750 deg. F., Strong, Carlisle and Hammond, 1392 W. 3rd St., Cleveland, Ohio, has introduced a welded steam trap.



All operating parts are of proved design and construction, including stainless bucket, Anum-Metl valve seat pins, antibalancing device, and easily inspected, internal bolted-in seat. Trap body is seamless steel tubing with steel cover.

New Blackout Bulb Unit

CHANGES in blackout bulb specifications have been announced by the Wabash Appliance Corp., Brooklyn, New York, whose silver lined blackout bulb was released in January.

The changes made as a result of recent tests have changed the color of the light to deep orange, as recommended by the Office of Civilian Defense. Other changes are in size, in reduced current consumption, in elimination of the former built-in reflector, and in the type of heavy black silicate coating used to prevent light leakage.

The deep orange light that the new unit provides is said to be ample to permit room occupants to see each other plainly, as well as furniture, windows and doors.

Why the Rapid Growth in the Use of

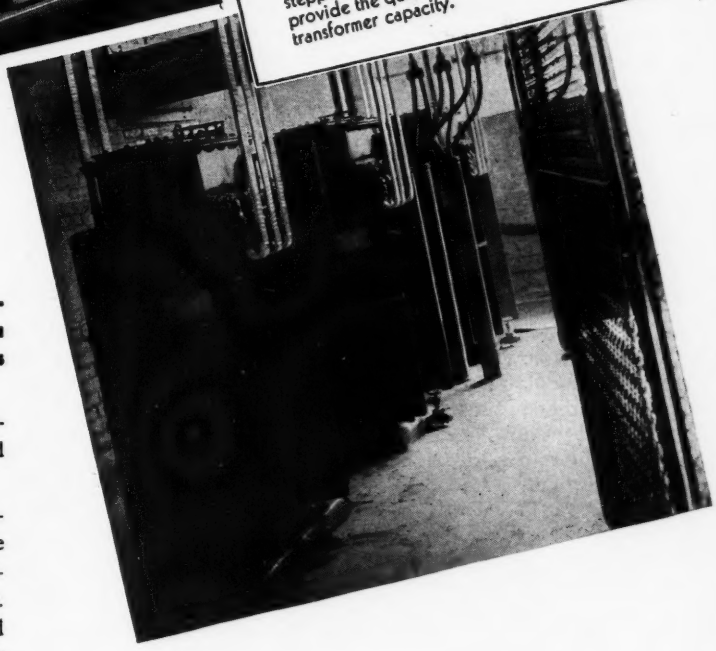
PYRANOL TRANSFORMERS?

FOR NEW PLANTS

Hundreds of Pyranol transformers—in G-E load-center unit substations—are supplying power for machines and lighting in new defense plants. The development of Pyranol, General Electric's noninflammable insulating liquid, first made possible the economical installation of high-voltage transformers indoors. No vault is required, because you can't burn Pyranol.

FOR PLANT EXPANSION

When this plant needed more power, it installed these Pyranol transformers indoors. They bring primary power close to the load. Long runs of heavy secondaries are eliminated, effecting major savings in copper. For plants that must have more power for stepped-up production, Pyranol transformers provide the quick, safe method of increasing transformer capacity.



HERE'S WHY

PYRANOL* transformers can be installed indoors—right at load centers—without a fireproof vault. This speeds installation and saves materials, particularly copper.

Pyranol is noninflammable, and no Pyranol transformer in the 10 years since Pyranol was introduced has burned, or contributed to a fire.

Pyranol transformers require little, if any, maintenance. Pyranol is nonoxidizing and nonsludging. The pressure-tight tank protects vital parts of the transformers against moisture, dirt, dust, and sabotage. Immersion of the transformer interior in the liquid Pyranol prevents drying and cracking of the winding insulation.

Pyranol transformers have high dielectric strength, both at normal frequency and impulse, which means greater ability to withstand voltage surges that originate from switching operations or lightning.

The heat-storage capacity inherent in liquid-filled transformers makes Pyranol units ideal for sustained emergency overloads.

The reliability of Pyranol transformers has been proved by 10 years of service. Total installed capacity of Pyranol transformers is more than 2,000,000 kva.

For complete information on Pyranol transformers for your requirements, consult your G-E representative. Or, write for Bulletin GEA-2048C. *General Electric, Schenectady, N. Y.*

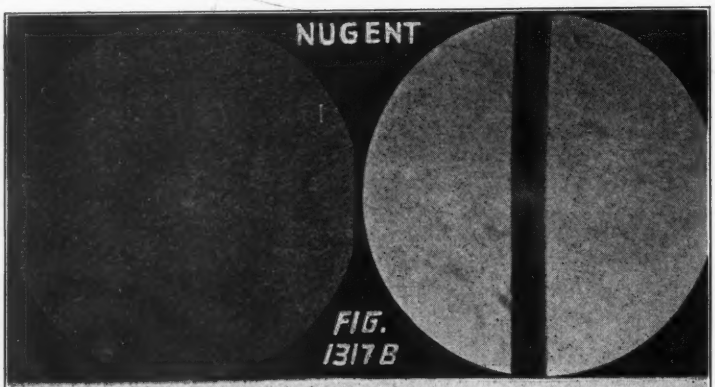
*Reg. U.S. Pat. Off.

General Electric and its employees are proud of the Navy award of Excellence made to its Erie Works for the manufacture of naval ordnance.

GENERAL ELECTRIC

402-40-5100

Here's a Proved Method for Conserving Lubricating Oil..



BEFORE AFTER
MICROSCOPIC PHOTO 100-X

—*Install* NUGENT FILTERS!

FOR obvious reasons, it is now more important than ever to conserve all grades of lubricating oil, as well as all other types of cutting oils, coolant, etc. One sure way to emphasize the conservation of oil is available through the installation of Nugent Filters in oil lines, to provide a positive method for removing dirt particles, and allowing complete recirculation of clean oil every cycle.

The photomicrograph reproduced above demonstrates the ability of Nugent Filters to remove harmful grit, dust, sand, carbon, abrasives, etc., from lubricating oils. This photo shows lube oil sample **before** and **after** installing a Nugent Absorbent (Waste) Type Oil Filter on a 600 H.P. Diesel. The "after" sample was taken at 1800 hours operation. Waste is renewed every 700 hours. The line through the "after" picture is a human hair. The large dirt particles in the "before" sample are about .0003".

Another big reason for the widespread use of Nugent Oil Filters is their ease of application. No complicated pipe connections—no redesigning of the lubricating system—a minimum of auxiliary fittings. And remember—**the oil is all that moves in a Nugent Filter, and it does not wear out!**

NUGENT Patented Pressure Filters have 20 TIMES MORE ACTUAL FILTERING AREA than most filters of comparable size. Nugent's special woven, acid resisting, lintless textile filter element removes particles as small as .0003" to produce 99-8/10% clean oil. In asking for quotations, please mention gals. per min. circulated and viscosity of oil at operating temperature.

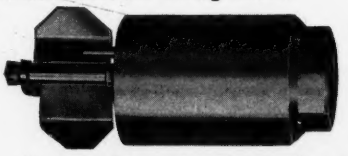
Wm. W. Nugent & Co., Inc. Mfrs.

Oil Filters, Oiling and Filtering Systems, Telescopic Oilers, Oiling Devices Sight Feed Valves, Flow Indicators, Compression Union Fittings, Oil Pumps, Etc.

423 N. HERMITAGE AVE. Established 1897 CHICAGO, U.S.A.

Soot Scraper

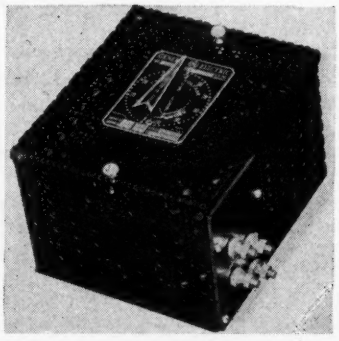
WITH COMPRESSED air or steam at a pressure of about 60 lb. psi. as the motive power, the newly developed Mohawk power scraper manufactured by the Brunt Equipment Co., 64 S. Division St., Buffalo, N. Y., is designed to remove soot and slag, and burnish the inner surface of the tubes of a fire-tube boiler. This is accomplished by whirling, self-sharpening blades that loosen the deposit which is then blown out by air or steam exhausted from the driving motor.



In operation, thorough cleaning is accomplished by the rapidity of travel and the sharp edge of each blade which swings around and glances off the tube metal without injuring the surface. When blades become worn they are easily removed and replaced. The scrapers are available for all sizes of fire tubes.

Variable-Voltage Autotransformer

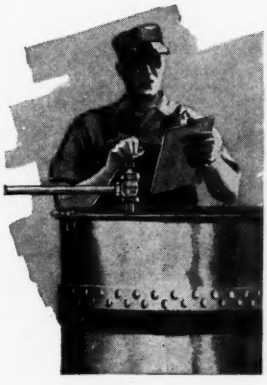
THE GENERAL ELECTRIC Co., Schenectady, N. Y., announces a line of variable-voltage autotransformers to provide smooth, adjustable control of uninterrupted voltage and of small amounts of power. Light in weight and small in size, these autotransformers are mechanically strong and are said to be well suited for use in factories, laboratories, and schools, or for assembly with other equipment. Designed for panel and bench mounting, they are for built-in applications and can be supplied without the enclosing cases.



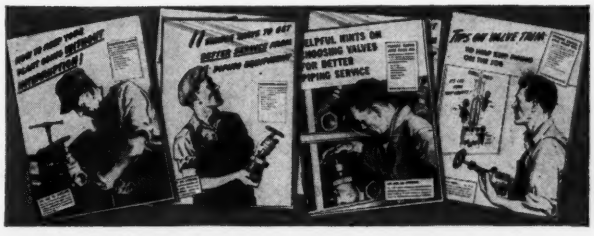
Electrically, the autotransformer has high efficiency and regulation throughout the entire range from no load to full load. It operates on low input power and low exciting current—this being made possible by a circular core, wound from low-loss silicon-steel strip to provide the magnetic circuit. The input circuit is connected to a winding made up of spaced turns of the round conductor that are insulated by Formex enamel. Connection to the output circuit is provided by a carbon brush and kept in constant contact with a non-insulated portion of the inside of the winding. Each turn of the conductor gives a different step in voltage. Changing the position of the brush, the output voltage can be varied uniformly without interrupting the load current. The dial on the cover is calibrated to indicate from 0 to 100 per cent of maximum output voltage.

. . . THAT PULLING UP A VALVE with the wrench on the unsupported end puts a severe strain on the body—that it may twist the valve and cripple its working parts, cause early leakage of the seats and shorten the life of the valve. Crane "Piping Pointers" showed me the right way—with my wrench on the pipe end of the valve. You get a firmer grip this way; pulling-up is easier with less chance of hurting the valve.

. . . THAT RODDING OUT of viscous and tarry fluid lines can be done easier and faster by installing cross fittings instead of elbows at the 90° turns. You'd be surprised the time it saves on lines requiring frequent cleaning. There's no need to tear them down—you just remove the plugs and work in either direction—another "kink" that helps keep production moving.



...THAT INSTALLING VALVES for easy operation is important in controlling speed and quality of production—to safety of processing equipment as well. You can't expect production workers to open valves fully, regulate them properly, or close them tight, if getting at them is difficult and dangerous. Yet, improper operation quickens wear on valves and often slows production.



. . . TAKE IT FROM ME, these Crane Shop Bulletins are sound and practical for training new men—for veterans as well! They're full of helpful "kinks" that make piping equipment work better. They're ideal for shop or classroom use. They're genuine aids to Victory and Crane is giving them *free* to any plant or piping man. Just ask your local Crane Representative or write direct to the address below.

CRANE

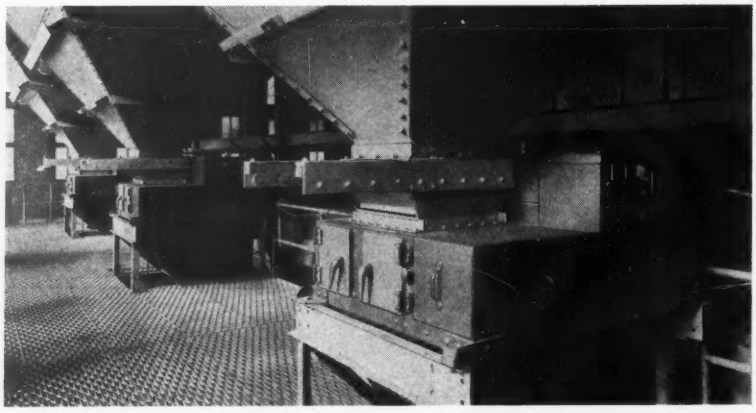
CRANE CO., GENERAL OFFICES:
836 SOUTH MICHIGAN AVENUE, CHICAGO

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

NATION-WIDE SERVICE THROUGH BRANCHES AND WHOLESALERS IN ALL MARKETS

INCREASE YOUR OPERATING EFFICIENCIES AND CONSERVE COAL

Richardson Automatic Coal Scales automatically provide continuous records of coal consumed by each boiler—an essential step toward *saving coal,* lowering cost of power and *increasing evaporation.*



Richardson Automatic Coal Scales in use at the Red Star Yeast Plant, Milwaukee, Wisconsin.

Now, more than ever before, you need accurate records of fuel consumption so as to avoid waste. If a boiler is evaporating say 9 lbs. of water instead of a possible 10 lbs. of water per pound of coal, that's a 10% waste or loss. The continuous records provided by Richardson Coal Scales will show up such inefficiencies immediately and steps can be taken to correct such condition—hence the use of Richardson Automatic Coal Scales will enable you to produce

MORE STEAM FROM LESS COAL

Richardson Automatic Coal Scales are designed to give year in and year out of dependable service at low maintenance cost—Machines are streamlined, dust-proof, and of welded construction, with easy access to all parts. Built to handle crushed coal—wet or dry—lumpy or slack —without interruption.

Bulletin 21240 gives complete technical data and illustrations of Richardson Scales, of standard and elongated models built to meet conditions in new and existing plants. Write for your copy today.

RICHARDSON

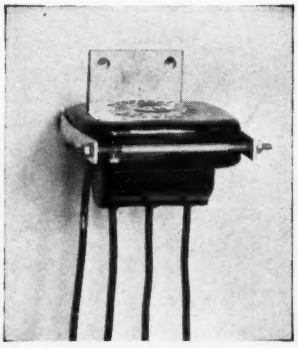
CHICAGO MINNEAPOLIS OMAHA WICHITA
SAN FRANCISCO ATLANTA BOSTON
NEW YORK PHILADELPHIA COLUMBUS

RICHARDSON SCALE COMPANY, CLIFTON, N. J.

2918

New Outdoor Protector

To SAFEGUARD watthour meters and secondaries of transformers against lightning, a new outdoor protector is announced by the Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa. With a cutoff line to ground rating of 500 v. r.m.s., the unit is for application on 3-phase circuits of from 110 to 575 v. Discharge capacity is 20,000 amp. crest, and gap breakdown on impulse is 2500 v. average.

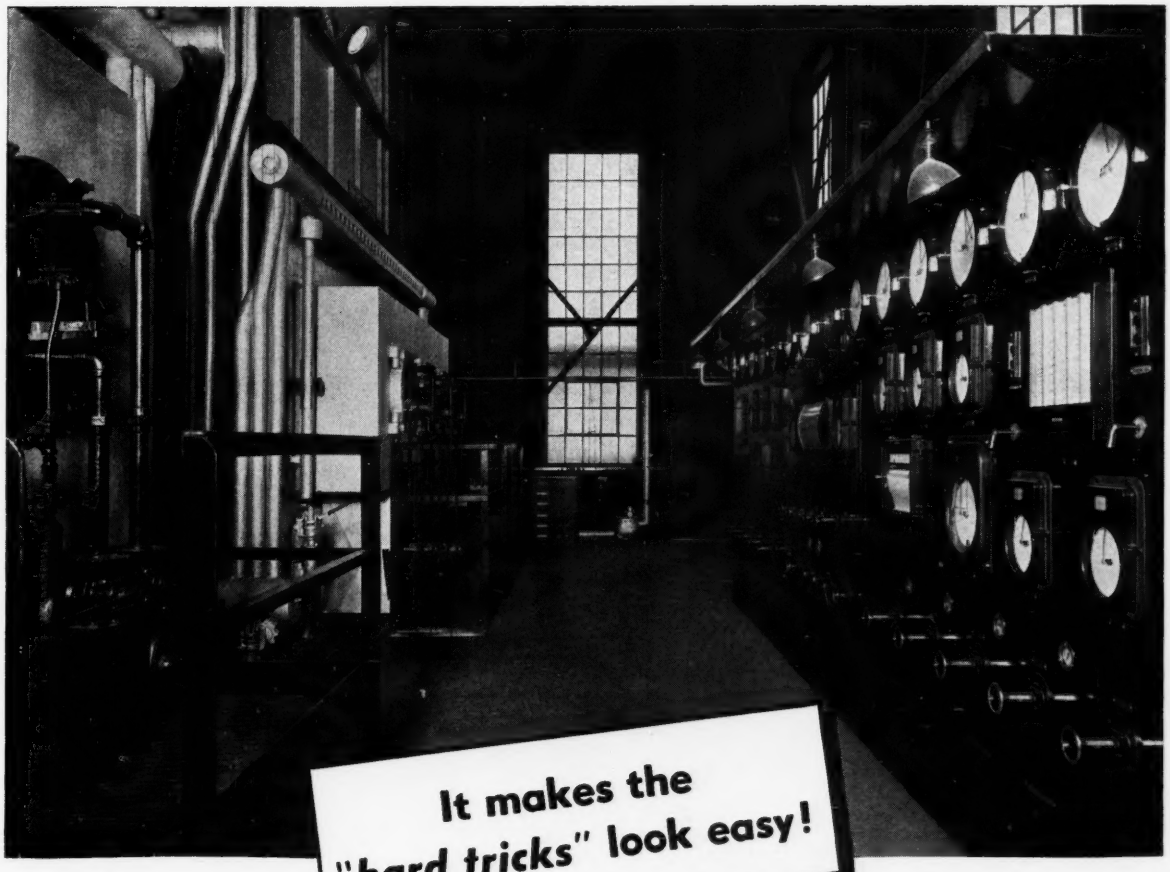


When installing, the protector ground load is grounded to the meter case or conduit, equalizing the meter coil and protector potentials. This eliminates the possibility of a flashover from the meter case to the potential coils in meters which are insulated in accordance with modern practice.

Safety Transformer

ACME Electric & Mfg. Co. of Cuba, New York has recently developed a safety transformer which provides for two 32 v. a.c. extension lines to provide light for the workmen who must perform their duties under conditions in which explosive gases or vapors exist. This also applies to those cases where inflammable materials are stored or in process, and where the possibility of a high voltage spark may cause considerable damage.

This unit is also particularly adapted for inspection work where workmen must come in contact with moist surfaces or conditions, for the lower voltage prevents severe shock due to defective wires or wiring. The Acme Safety Transformer is a compact portable instrument that may be easily carried about the plant and plugged into any ordinary 110 v. a.c. circuit. It is heavily insulated throughout, and is approved by the Underwriters' Laboratories. Mounted in one end of the unit are dual polarized secondary receptacles for two 32 v. a.c. extension lines a plug-in for inspection lights.



OPERATING men who have had an opportunity to watch the operation of Askania Combustion Control will tell you that it stands distinctly apart. Its ability to meet any load requirement—to operate with the minimum amount of attention—are factors which are important in these times when man-power must be used to the greatest advantage.

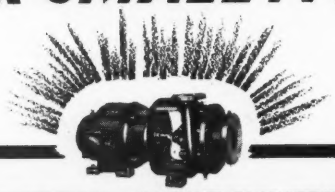
An example of this is the installation illustrated above. Two boilers normally burning coke oven gas are controlled to automatically supplement this fuel with oil whenever a deficiency occurs.

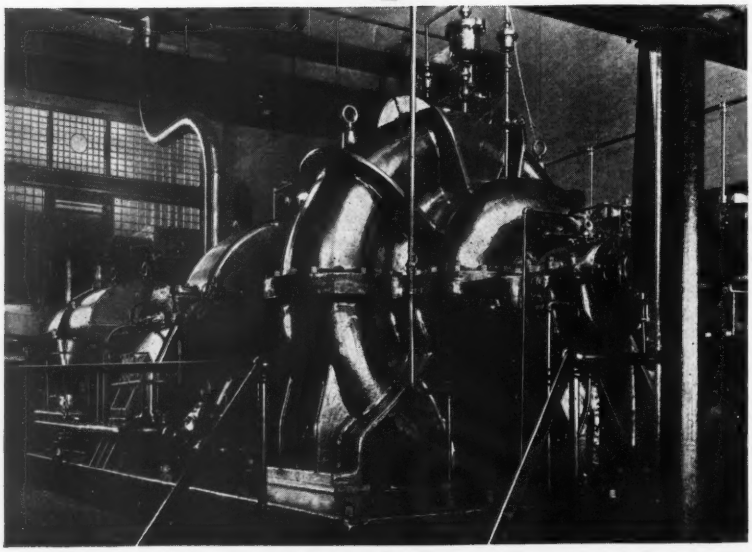
If you have a combustion control problem where the operating conditions are "tough", it is a job for Askania —the control that makes the hard tricks easy.

ASKANIA REGULATOR CO., 1601 S. Michigan Ave., Chicago, Ill.

ASKANIA
REGULATOR CO. CHICAGO
AUTOMATIC CONTROL

For LARGE Capacities OR SMALL . . .





WARREN PUMPS

'are Built To Fit the Job

Whether a pumping job calls for *tremendous* capacities or small ones, you can count on Warren Pumps to give dependable, long and low-cost performance. *Every* Warren Pump is built to fit the job . . . with *no compromising* with sound engineering principles.

All Warren Pumps have good details. They have liberal clearances that insure highest practical efficiencies and low power costs, year after year. They have extra heavy shafts that minimize internal wear . . . over-size bearings . . . broad-faced case rings . . . properly proportioned liquid passages.

To help us "do the impossible," as Mr. Donald Nelson says that we *must* do—call on Warren Pumps for uninterrupted service.

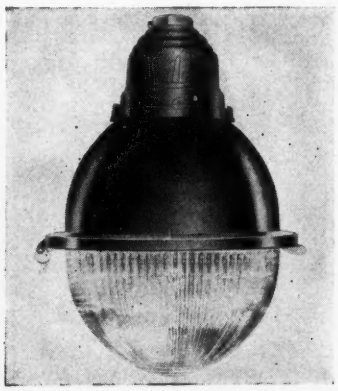
WARREN STEAM PUMP COMPANY, INCORPORATED

Warren, Massachusetts

Street Lighting Luminaire

DESIGNED specifically for lighting streets in the vicinity of defense plants, army cantonments, and for protective lighting of fences around vital industrial areas, a new street lighting luminaire, Type SG-10, has been announced by Westinghouse Elec. & Mfg. Co., Edgewater Park, Cleveland, Ohio.

The reflector housing is heavy gage steel porcelain enameled inside and out. A silvered glass reflector, instead of aluminum, contributes to the high reflectivity of the unit. This silvered glass reflector has a metallic backing that will not chip or peel off under extreme heat conditions.



For symmetric distribution three globes are available in clear or alabaster glass. For asymmetric distribution, refractor globes are available in four designs which are of clear glass with the prisms on the inside and rectilinear design on the outside.

The unit is available for series or multiple service. It can be equipped with high or low-voltage metal head for internal or external wiring, top or side mounting.

Window Glass Coating

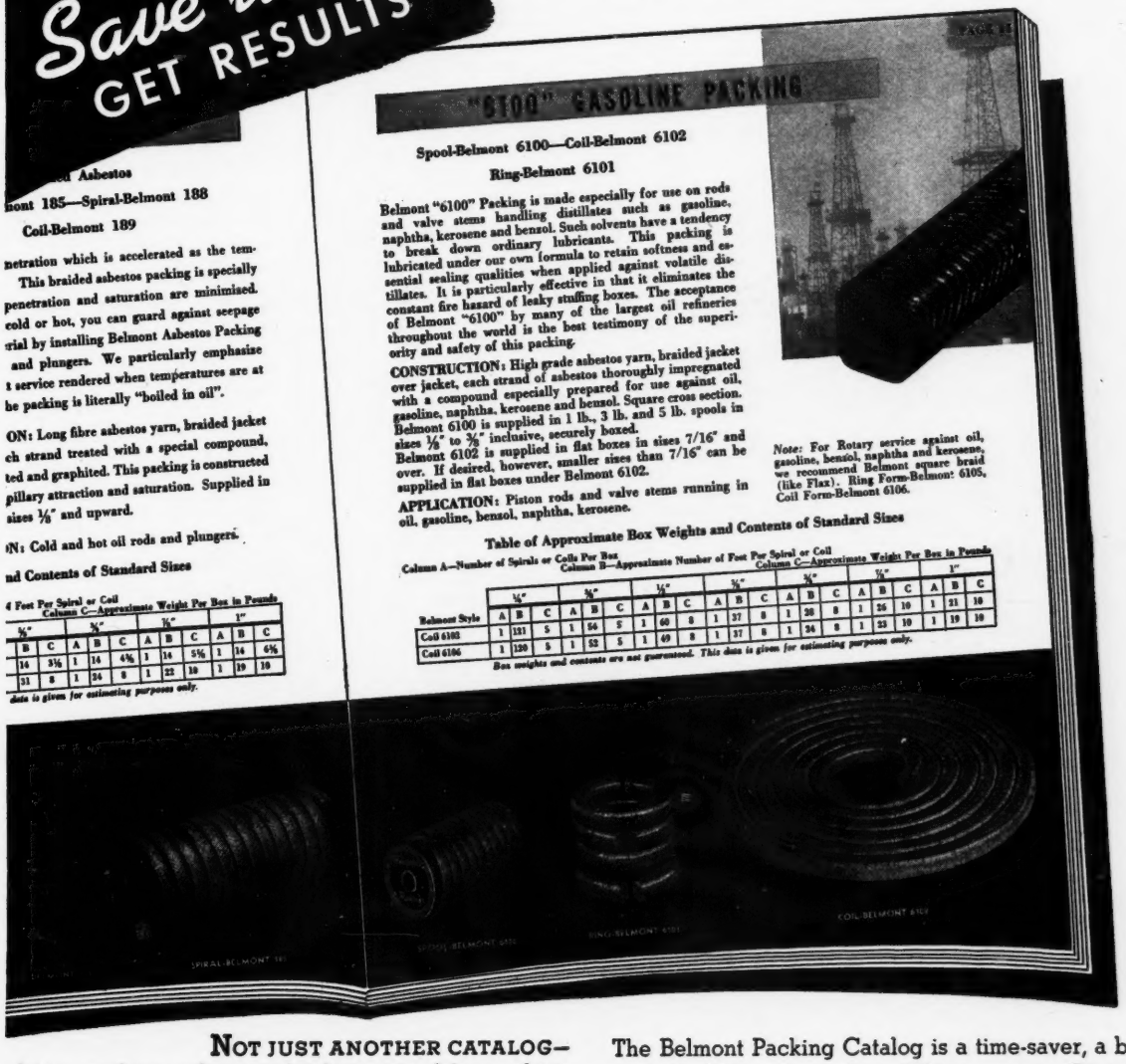
TO PREVENT the hazard of flying window glass during air raids, a new coating is being offered by Douglas Distributors, Inc., of New York City. This new coating known as Protex Shatter Proof Blackout Coating No. 4, has the property of holding glass splinters together, even though the window may be shattered into fragments. It is applied with a brush to the inside of windows, washes off easily with water and a cloth, makes a window absolutely opaque for the period of a year or more under normal conditions.

An outside black coating, another product of American laboratories, is also being distributed by Douglas Distributors, Inc. This coating is sprayed or brushed on the outside of windows, forming a dense, flat black finish which is impervious to all weather conditions. This outside coating dries in half an hour avoids all danger of reflection, yet can be readily removed at any time with a cloth and kerosene. Known as Protex-Rowe No. 200 Outside Blackout Coating, it will not cause windows to crack or split under the heat of the sun's rays, thus overcoming one of the major difficulties experienced by defense plants with similar products.

BELMONT PACKINGS

Use the Belmont Packing Catalog to Solve Your Packing Problems

Save time.. GET RESULTS



...l Asbestos
...mont 185—Spiral-Belmont 188
Coil-Belmont 189

...netration which is accelerated as the tem-

This braided asbestos packing is specially
penetration and saturation are minimized.
cold or hot, you can guard against seepage
...rial by installing Belmont Asbestos Packing
and plungers. We particularly emphasize
...t service rendered when temperatures are at
...he packing is literally "boiled in oil".

...ON: Long fibre asbestos yarn, braided jacket
...ch strand treated with a special compound,
...ted and graphited. This packing is constructed
...pillary attraction and saturation. Supplied in
sizes 1/8" and upward.

...N: Cold and hot oil rods and plungers.

...nd Contents of Standard Sizes

...t Per Spiral or Coil
Column C—Approximate Weight Per Box in Pounds

⅛"			¼"			⅜"			1"		
B	C	A	B	C	A	B	C	A	B	C
14	3½	1	14	4⅝	1	14	5⅝	1	14	6⅝
31	8	1	24	8	1	22	10	1	19	10

...data is given for estimating purposes only.

"6100" GASOLINE PACKING

Spool-Belmont 6100—Coil-Belmont 6102
Ring-Belmont 6101

Belmont "6100" Packing is made especially for use on rods and valve stems handling distillates such as gasoline, naphtha, kerosene and benzol. Such solvents have a tendency to break down ordinary lubricants. This packing is lubricated under our own formula to retain softness and essential sealing qualities when applied against volatile distillates. It is particularly effective in that it eliminates the constant fire hazard of leaky stuffing boxes. The acceptance of Belmont "6100" by many of the largest oil refineries throughout the world is the best testimony of the superiority and safety of this packing.

CONSTRUCTION: High grade asbestos yarn, braided jacket over jacket, each strand of asbestos thoroughly impregnated with a compound especially prepared for use against oil, gasoline, naphtha, kerosene and benzol. Square cross section. Belmont 6100 is supplied in 1 lb., 3 lb. and 5 lb. spools in sizes 1/8" to 3/8" inclusive, securely boxed. Belmont 6102 is supplied in flat boxes in sizes 7/16" and over. If desired, however, smaller sizes than 7/16" can be supplied in flat boxes under Belmont 6102.

APPLICATION: Piston rods and valve stems running in oil, gasoline, benzol, naphtha, kerosene.

Note: For Rotary service against oil, gasoline, benzol, naphtha and kerosene, we recommend Belmont square braid (like Flax). Ring Form-Belmont 6105, Coil Form-Belmont 6106.

Table of Approximate Box Weights and Contents of Standard Sizes

Column A—Number of Spirals or Coils Per Box
Column B—Approximate Number of Feet Per Spiral or Coil
Column C—Approximate Weight Per Box in Pounds

Belmont Style	⅛"			¼"			⅜"			½"			⅝"			¾"			⅞"			1"		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Coil 6102	1	131	5	1	56	5	1	60	8	1	37	8	1	36	8	1	25	10	1	21	10			
Coil 6106	1	120	5	1	53	5	1	69	8	1	37	8	1	34	8	1	23	10	1	19	10			

Box weights and contents are not guaranteed. This data is given for estimating purposes only.

NOT JUST ANOTHER CATALOG—but a packing reference book prepared by packing engineers. 84 pages of packing information, all reduced to its simplest form; with each and every type of Belmont packing clearly illustrated and described—as shown in the facsimile page above.

The Belmont Packing Catalog includes recommendation charts that enable you to check instantly, by type of service, Belmont's choice of packing styles (listed in the order of our selection). Packing end views are pictured in large size showing minute details. Construction, applications, tables of weights and measures are all laid out in easily readable form so that everything can be taken in at a glance.

The Belmont Packing Catalog is a time-saver, a book you should not be without. Write on your Company letterhead for your copy today.

There's a Belmont Packing for every service: Steam, Water, Oil, Gas, Air, Acid, Alkalis, Ammonia. Forms include: Rings, Coils, Spirals, Reels, Spools, Sheets, Gaskets. Whatever the need, Belmont has it.

Belmont Packings are Sold by Authorized Belmont Distributors in Every Large Industrial Center.

THE BELMONT PACKING & RUBBER CO.

Dept. P.P.-542

Butler and Sepviva Streets • Philadelphia, Pa.

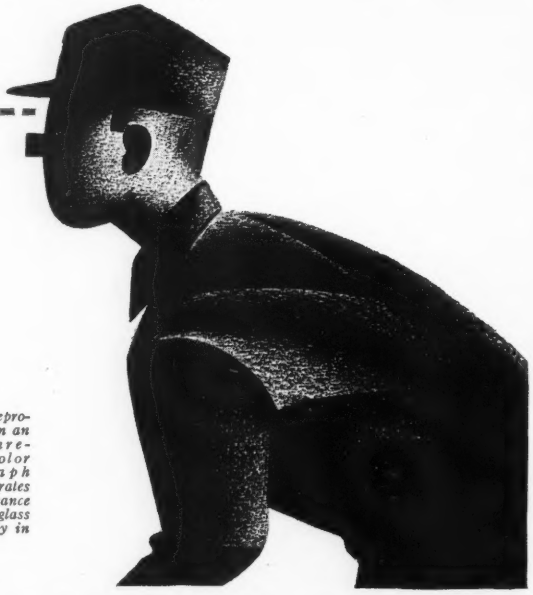
PYREX Red Lines CAN ALMOST TALK

Even in a poorly lighted boiler room a PYREX Broad Red Line Gauge Glass will shout for attention.

That's a fact you can prove to yourself. Cut out the illustration at the left. Place it beside any regular gauge glass in your plant. At arm's length or a hundred feet away, the broad red line *stands out.*

With a PYREX Broad Red Line Gauge Glass you are always sure of water-level visibility. And visibility is protected, too, for PYREX brand Gauge Glasses have the qualities it takes for long-life serviceability. Resistance to thermal shock and the corrosive attacks of steam together with machine-drawn accuracy that lessens installation strains help cut your gauge glass costs.

PYREX Broad Red Line Gauge Glasses are stocked by leading mill and steam supply dealers.



At left, a reproduction from an actual untouched color photograph which illustrates the appearance of the gauge glass from directly in front.

"PYREX" is a registered trade-mark and indicates manufacture by Corning Glass Works.

CORNING Glass Works Corning, New York — Pyrex Gauge Glasses

Wanna Buy a Duct?

When next you are in the market for an air duct or chimney, boiler or drive belt, water pump or steam purifier—consult the "Where To Buy" Directory of POWER PLANT ENGINEERING. It's the quick and easy answer to your questions of who makes what in the power industry.

Fire Extinguishing Compound

DUGAS Engineering Corp., Marinette, Wis., has recently announced a new dry fire-extinguishing compound, duMag, a powder developed specifically for extinguishing magnesium and incendiary-bomb fires. Its advantages over salt or sand are said to be: Takes less to extinguish the fire, it is moisture-resistant, remains free-flowing even when stored for long periods, is non-abrasive, and will not react with burning magnesium.

DuMag powder is a blend of various chemicals in correct proportions to give the desired characteristics. It can be applied directly from the container to the fire, or to the burning bomb, with scoop, shovel, extinguisher, or other mechanical means.

It is available in 45-lb. pails and in 12-lb. tubular containers. The quantity in the tube is said to be amply sufficient to extinguih the common 2-lb. magnesium-thermit type incendiary bomb.

Luminaires for Protective Lighting

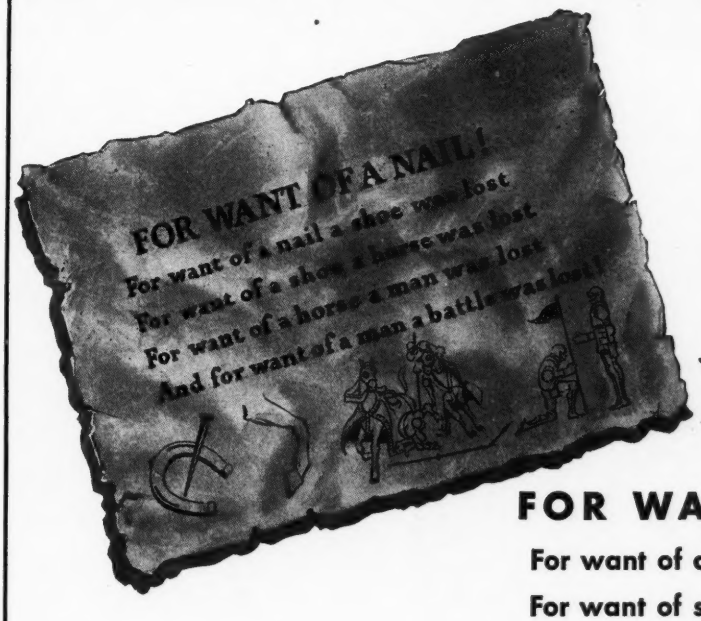
FOR LIGHTING industrial fences and areas for protection against sabotage, Fresnel luminaires have been recently announced by the Westinghouse Lighting Division, Cleveland, Ohio. Two types are available SF-180 and the MF-180 for series and multiple circuits respectively.

The units can be mounted on poles and building walls and consists basically of a hood with socket and receptacle, mounting bracket, a reflector and lens assembly.

The hood is made of cast iron. The lower part of the casting has a flange for watershed and breather to avoid creation of a vacuum due to sudden cooling of the luminaire by rain. Moistureproof felt gaskets form a weatherproof and bug-proof seal between the hood and the reflector. The units with side mounting plates are gasketed with graphitized asbestos.

Photoelectric Blackout Control

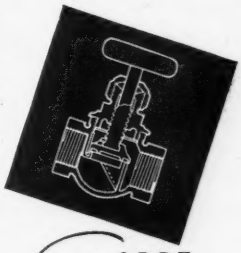
FOR CONTROL of store window displays and outdoor billboards, Photoswitch Incorporated, Cambridge, Mass., has recently developed a blackout switch that is alined with the nearest street lamp. When the centrally controlled street lamp is turned out, the switch turns out the illumination it is controlling. The new control operates from 115 volts, A.C., but other types are available for D.C. operation. The units are for installation within 100 ft. of a street lamp, and supplied in dustproof and moisture proof housings.


FOR WANT OF A NAIL!
For want of a nail a shoe was lost
For want of a shoe a horse was lost
For want of a horse a man was lost
And for want of a man a battle was lost!

FOR WANT OF A VALVE

For want of a valve, steam was lost
For want of steam, metal was lost
For want of metal, a plane was lost
For want of a plane, a fortress was lost!

THAT rhyme is just another way to say that it now has become imperative that valves—particularly the valves *you* use—be maintained at the peak of efficiency. . . . Ordinarily that might mean replacement of many valves. But today valve metals are on the critical list. It has become un-American to replace valves that can be restored through repair or replacement of parts. And it is true Americanism to revert to old time thrift when checking the conditions of each valve and *"use it, mend it, make it do."* . . . As a matter of fact, Pratt & Cady, by their invention of the Globe Valve with renewable seat and disc made this possible. You *can* renew your valves by first, resurfacing disc and seat—or wedge and seat—to a new seal. Then, when they are completely worn out, replace only these smaller parts. To be sure, the delivery of seats and discs is also subject to government regulations, making it good business to check the condition of your valves in plenty of time.



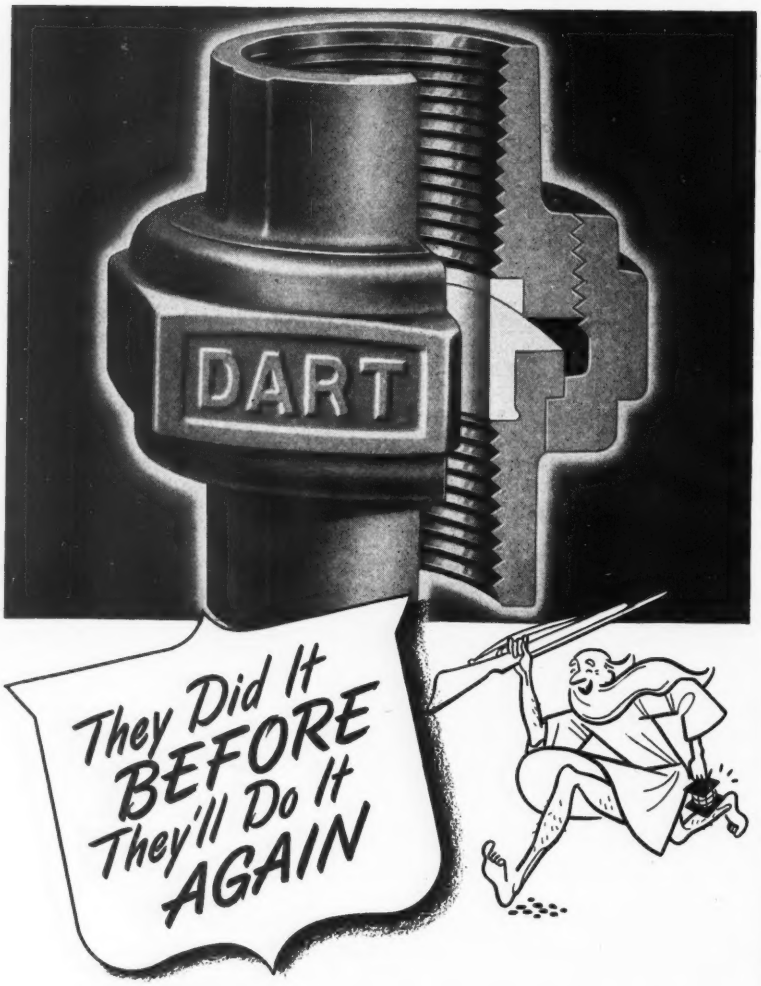
1885

Taken from one of the original Pratt & Cady Globe Valve patent drawings

READING-PRATT & CADY
READING, PENNSYLVANIA

A Division of AMERICAN CHAIN & CABLE COMPANY, INC. Bridgeport, Conn.

Put Your Used Darts BACK TO WORK



Search your plant for Dart Unions that have already "done their stuff". They can do it again. That is, they can *still* make up tight and the first time, quickly and easily—and *stay* tight unfailingly.

Magic performance? Not quite. A Dart's long life is due to a Dart's construction . . . its matched bronze seats, ground to "true-ball" surfaces . . . air refined malleable iron nuts and bodies that resist pipe abuse and corrosion.

In the interest of metal conservation, make *all* your used Dart Unions count. And get in touch with your supplier now if you need new ones.

DART UNIONS

E. M. DART MFG. CO., PROVIDENCE, R. I.

Sales Agents: The Fairbanks Company New York, and all branches
Canadian Factory: Dart Union Company, Ltd., Toronto, Canada

MANUFACTURERS' NEWS

Tube-Turns, Inc., Louisville, Ky., recently opened up a new branch office in Houston, Tex. Located in the Commerce Bldg., the office will be managed by W. B. Whenthoff, formerly in charge of the company's Tulsa, Okla., office.

Charles C. Phelps Co., which represents W. H. Nicholson & Co., Ellison Draft Gage Co., Levitt Machine Co., Marion Machine Foundry & Supply Co. and other specialty manufacturers, announces removal of its offices from 98 Park Pl. to 39 Cortlandt St., New York City.

Whiting Corp., Harvey, Ill., has announced the acquisition of the Hydro-Clone line of dust and fume suppression equipment, used in foundry and industrial applications. The equipment department will be headed by E. F. Fisher, inventor of the units.

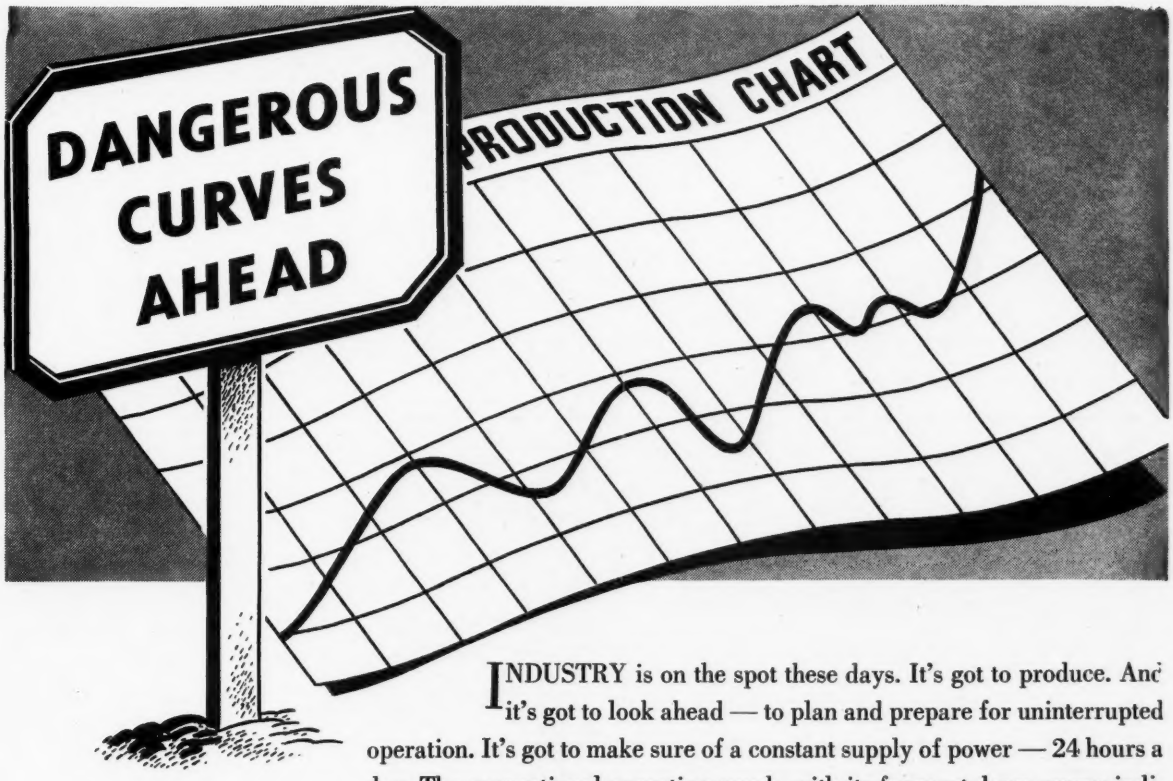
To increase the production of seamless tubing of alloy and stainless steel, essential to war effort, United States Steel Corp. announced the formation of a new subsidiary company, Tubular Products, Inc. The new company which has acquired the plant of the National Tube Co., in the Chicago district at Gary, Ind. Benjamin F. Harris, president of National Tube Co., will head the new company. Other officers who will have headquarters at Gary include E. N. Sanders, vice-president; A. Gordon Patterson, secretary and treasurer; E. M. Moore, comptroller; R. W. Wire, sales manager, and L. W. Mason, director of purchases. All are formerly of National Tube Co.

The Division of Industry Operations of the War Production Board has announced the formation of the High Pressure Valve Industry Advisory Committee. The members include: L. D. Seymour, Pittsburgh Valve & Fittings Corp., Barberton, Ohio; C. S. Bigelow, Milwaukee Valve Co; and R. L. O'Brien, Detroit Brass & Malleable Works. Carl M. Lynge is government presiding officer, and W. W. Timmis has been named alternate government presiding officer.

Allis-Chalmers Mfg. Co. has recently presented nearly 6000 employes with certificates and emblems of service, ranging from 10 to 50 yr.

A group of 41 were presented with diamond studded pins in recognition of 50 or more years of service. In addition to the service awards, each of the veterans was given a copy of the new Allis-Chalmers publication, "We Work For Victory And We Plan For Peace," and tickets to a special showing of the new company picture of the same name.

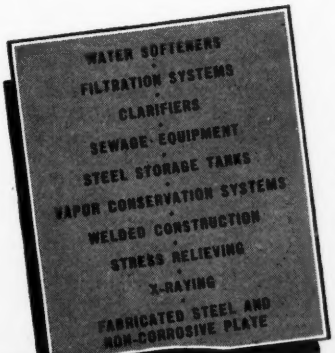
R. R. Wason, president of Manning, Maxwell & Moore Inc., announced recently the liquidation of the Railway and Mill Supplies Division at Jersey City, New Jersey, to strengthen and expand the manufacturing end of the corporation, which will increase the important contribution to the cause of war production.



INDUSTRY is on the spot these days. It's got to produce. And it's got to look ahead — to plan and prepare for uninterrupted operation. It's got to make sure of a constant supply of power — 24 hours a day. The conventional operating graph, with its frequent down curves indicating time out for boiler cleaning, must be straightened out. These down curves mean lost time — lost man-hours — lost production.

Proper conditioning of feed water will eliminate these dangerous curves. It will provide a straight-away for continuous maximum production. And that's what we must have if we're to "keep 'em rolling, flying, and sailing."

In the interests of National Defense you should check your water conditioning equipment without delay. And if you are confronted with a problem, consult Graver at once. With more than 30 years experience in the design and manufacture of water conditioning equipment of all types, Graver is in a position to make a thorough analysis of the situation and submit unbiased recommendations.



Ask for these Graver Bulletins today.

Bulletin 301. Pictures and describes Graver Pressure Filters. Explains general construction and contains specification tables for both horizontal and vertical types.

Bulletin 303. Fully describes the Graver Hot Process Water Softener. Also contains detail drawings of two types of equipment plus other interesting information.

Bulletin 307. Covers Graver Zeolite Water Softeners as well as the six types of Graver Zeolites. Contains a series of six interesting flow diagrams covering waters of various characteristics.

GRAVER

GRAVER TANK & MFG. CO., INC.

NEW YORK
CATASAUQUA, PA.

4809-8 TOD AVE.
EAST CHICAGO, IND.
CABLE ADDRESS — GRATANK

CHICAGO
TULSA

42-15-W

The visual instruction section of General Electric has taken over a color film series, "Inside of Arc Welding," for non-commercial distribution to schools and study groups to speed up war production training.

Fundamentals, the first picture in the series completed, will be followed by five additional subjects now in final script, and it is planned to have the series completed by June.

Subjects to be covered in the training productions are Flat Arc Welding, Horizontal Arc Welding, Flat and Horizontal A.C. Welding, Vertical Arc Welding and Overhead Arc Welding.

Detail in each step of welding will be illustrated with charts and diagrams as well as photographic action. The technical sequences for the pictures will be done in the Schenectady plant of G.E. and the productions will be completed in Hollywood.

In a paper read before the American Society of Mechanical Engineers, at their mid-year meeting at the Hotel Rice, Houston, Texas, it was stated that the development of fin-tubes in heat exchanger equipment saved considerable metal originally required for tube construction. The author of the paper was A. Y. Gunter, development director of the Alco Products Division of the American Locomotive Company.

He estimated that the savings affected by this type of equipment in many cases may run as high as 40 per cent. It was further estimated that the use of fin-tubes where applicable in place of the more conventional type bare tubes, in heat exchangers, would make a saving of 65 to 75 per cent in the number of tubes required. Mr. Gunter also pointed out that oil exchangers containing the fin-tube construction are being used importantly in the U. S. Navy shore bases and on U. S. destroyers, cruisers and other warships, as well as in the oil industry throughout the country.

Conversion of a long idle textile processing plant in Sunbury, Pa., to manufacture bulkier types of communication facilities for the Government was announced by Walter C. Evans, general manager of the Westinghouse Broadcasting, Radio and X-ray Divisions. The plant was formerly used for the printing on patterns on silk.

Equipping the plant was started in March, and manufacturing operations employing 400 people was planned for the latter part of April

At a cost of $822,610, the Westinghouse Elec. and Mfg. Co., Denver, Colo., will furnish the 10 additional transformers to be installed in the Grand Coulee Dam power plant. From two large 108,000-kw. generating units, the plant on the Columbia River is already generating power. The transformers will be delivered at specified times over a period of 450 days.

A third large generator is scheduled for operation next month and will bring the installed capacity of the plant to 324,000 kw. With a total capacity for 1,944,000 kw. the Grand Coulee plant will be by far the largest hydro-electric plant in the world.

Inventories of unit heaters, unit ventilators, convectors, and blast heating coils have been frozen in the hands of manufacturers by a telegraphic order, it was announced March 26 by the WPB.

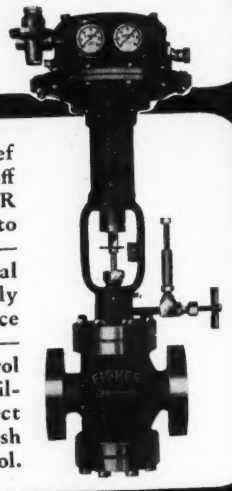
Managing Director of Coal Bureau

JULIAN E. TOBEY, vice-president of Appalachian Coals, Inc., has recently become managing director of the newly formed Coal Bureau of the Upper Monongahela Valley Association with headquarters in Fairmont, W. Va. The new bureau is formed to exploit the vast reserves of high volatile low fusion coals in this region and increase the use through the installation of modern combustion equipment.

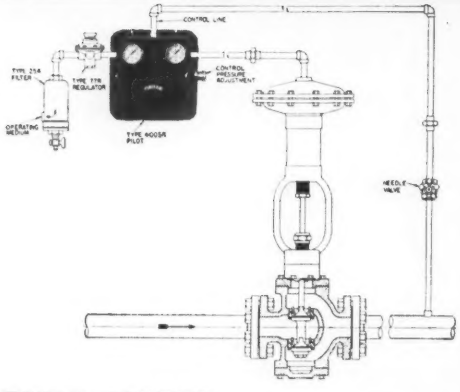
Mr. Tobey is widely known for his knowledge of fuels and has developed many phases of fuel engineering. He served as chief power engineer for the Studebaker Corp., as an engineering officer of the U. S. N., and as a consultant. Active as a member of several nationally known engineering societies, and past chairman of the Coal Division of the A. I. M. E., Mr. Tobey is a member of Ohio State Board of Registration for Professional Engineers and Surveyors, Director of Engineering for the Coal Producers Committee for Smoke Abatement, a member of the Executive Committee, Fuels Division, A. S. M. E., and active in the affairs of Bituminous Coal Research, Inc.

In 1934 Mr. Tobey was selected to organize and head the Fuel Engineering Division of the A. C. I.

FISHER WIZARD PILOTS
ASSURE SENSITIVE PRESSURE CONTROL



For full throttling pressure reducing or relief service — safety relief or safety shut-off service — your logical choice is a FISHER WIZARD PILOT. They are applicable to standard motor valves for general service — to forged steel bodied motor valves for special high pressure applications — to butterfly valves for low pressure, large volume service — to low pressure boiler gas fuel governors — to special heavy duty, severe service control valves. FISHER WIZARD PILOTS are available in Integral mounted type for direct connected control — and in Surface or Flush mounting types for remote panel control.



TYPE 4155SR . . Surface wall mounting type WIZARD PILOT (reverse acting) with reverse acting diaphragm valve for pressure reducing service. Main valve closes on loss of operating medium pressure and closes with increasing controlled pressure.

WIZARD PILOTS FEATURE:

3 Different types of mounting: Integral with diaphragm casing — Surface or wall mounting — Flush or panel mounting.

Full throttling range adjustment, 1% to 75%; Vernier screw adjustment of controlled pressure setting.

Gas tight and weather proof housing for outdoor installations.

Wide range of bronze and steel Bourdon tubes for pressures up to 10,000 lbs.

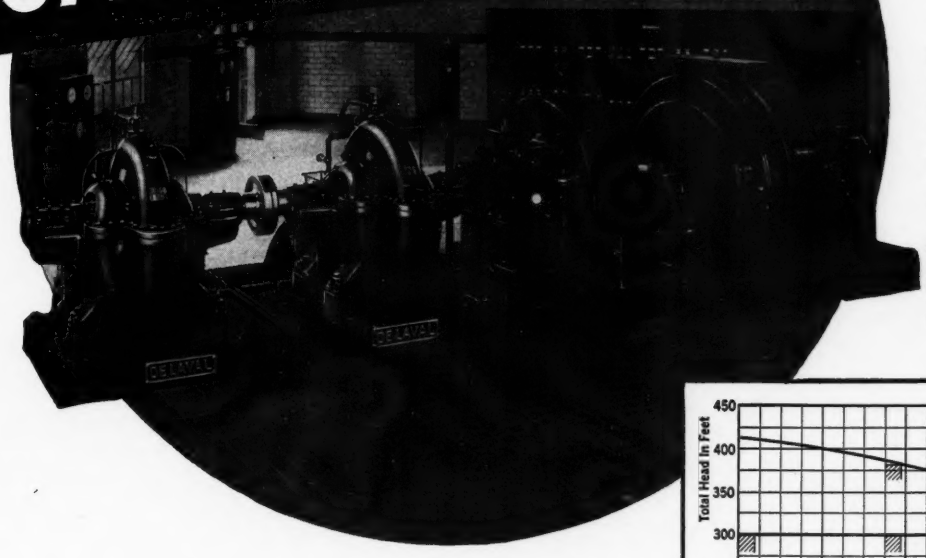
Simple change-over from direct to reverse acting or vice-versa.

Simplicity of design—extreme sensitivity—absolute dependability.

★ **SEND** *for FISHER Bulletin D for full information on WIZARD PILOTS — your copy will gladly be sent on request.*

FISHER GOVERNOR COMPANY
1008 Fisher Building
MARSHALLTOWN, IOWA

SAVES POWER COST BY VARYING PUMP SPEED

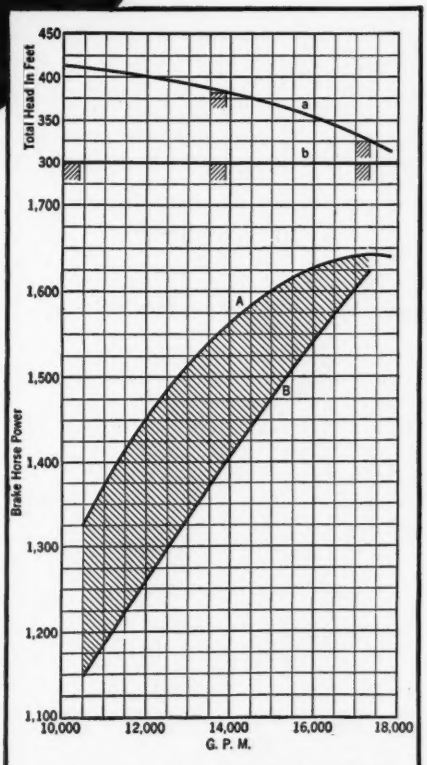


New De Laval pumping unit in Kansas City, Kansas, water works. Two pumps connected in series and driven through variable speed coupling by synchronous motor; 25 m. g. d. against 325 ft. at 700 r. p. m. pump speed.

The head developed by a centrifugal pump running at constant speed drops off with increase of flow, as in curve (a), while the head required by the system, as in curve (b), may be constant, or may even drop off at the lower deliveries. Under such conditions, to control the delivery by throttling is wasteful of power.

THE DE LAVAL VARIABLE SPEED PUMP DRIVE

effects notable economies by varying the speed of the pump so that it generates just the head required at different flows. The power delivered by the motor when reduced flow is obtained by throttling a pump running at constant speed is shown by curve A, while the power required from the motor when the pump is driven through a variable speed coupling is shown by curve B. The shaded area shows the power saved. The variable speed coupling also permits of starting the motor without load, a valuable advantage with synchronous and high efficiency induction motors. For further details see Publication P-4102.



a—Constant speed head-capacity characteristic.
b—Characteristic desired, obtainable either by throttling or by varying the pump speed.
A—Motor output with pump coupled to run at constant speed.
B—Motor output with pump driven through variable speed coupling.

DE LAVAL STEAM TURBINE COMPANY
Trenton, New Jersey

MANUFACTURERS' PERSONALS

The appointment of S. J. Horrell as vice-president of Associated Piping & Engineering Co. Ltd., was recently announced by George Humiston, president. Mr. Horrell was formerly associated with the Blaw Knox Co., Pittsburgh, as vice-president of their Power Piping Division in charge of sales and engineering, and previous to that was associated with the Grinnell Co., Providence, R. I. His headquarters will be in Los Angeles.

A. John Baumgarten has been appointed Manager of Sales for the Central Pennsylvania district of the McClave Co. His headquarters will be at the company's home office, 751 Mill St., Allentown, Pa.

Mr. Baumgarten is a graduate engineer of Cornell University and has been associated with the Pennsylvania Power & Light Co. for the past 14 yr.

Appointment of P. Y. Danley as assistant manager of the Merchandising Division, and H. F. Hildreth as manager of commercial refrigeration and air conditioning, with headquarters in Springfield, Mass., was recently announced by T. J. Newcomb, division sales manager, Westinghouse Elec. & Mfg. Co.

Mr. Danley, associated with Westinghouse for 29 yr., will also continue to have charge of war products, which he has had since 1941.

Mr. Hildreth, in service since his graduation from Pratt University in 1920, has recently been sales development manager of the department he now heads.

At the recent annual meeting of the stockholders of the Link-Belt Co., Chicago, Ill., Alfred Kauffmann, B. A. Gayman and J. Reece Lewis were re-elected as directors for 3 yr. Other directors also elected were Clarence Tolan, Jr., President of the Dodge Steel Co., Philadelphia, who succeeds Wellington Wells; and William C. Carter, executive vice-president of the Link-Belt Co., Chicago, succeeding George L. Morehead. Mr. Tolan and Mr. Carter were elected for 3 yr. and 2 yr. respectively.

K. L. Kirkpatrick has been recently appointed manager of the renewal parts section, of the Westinghouse Elec. & Mfg. Co. Mr. Kirkpatrick joined the Company in 1922; entering the Technical Night School he received his engineering certificate four years later.

Appointment of Wallace K. Brown as vice-president in charge of procurement for the Crocker-Wheeler Electric Manufacturing Co., is announced. His new duties will include coordinating and expediting all the related functions of the procurement and purchasing departments.

Mr. Brown has been associated with the Crocker-Wheeler organization since completing his technical training at Clarkson College of Technology and the University of Illinois, in 1908, and has served as district manager in San Francisco and Newark, and eastern sales manager in New York. He is located at the company's executive offices at Ampere, N. J.

J. H. Matthews and O. H. Cilley were elected to the Board of Directors of Raybestos-Manhattan, Inc., at a recent stockholders meeting in New York.

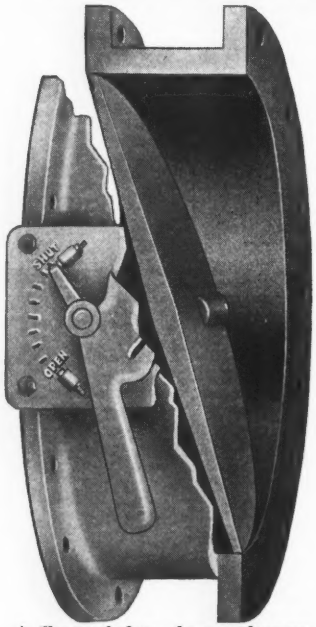
Mr. Matthews is assistant general manager of the Manhattan Rubber Mfg. division at Passaic, N. J., and Mr. Cilley is assistant general manager of the United States Asbestos division, Manheim, Pa.

W. S. Parrish has been named division sales manager of Iron Fireman, with headquarters at 3114 Washington Ave., St. Louis, Mo. The division is a consolidation of the former midwest district with the Mississippi Valley district.

Mr. Parrish started with Iron Fireman as a retail salesman, and served later as a dealer and a district representative in the Illinois-Indiana division.

W. E. Geiser, connected with Tube-Turns, Inc., Louisville, Ky., has been named district manager of the Philadelphia office. Mr. Geiser has been associated with the company since 1929.

R-S BUTTERFLY VALVES



As illustrated above, the vane closes naturally against the body of the valve and at the correct angle for wedge-tight shut-off. Machined to exceptionally close tolerances. Substitute metals are available to meet any operating condition.

PRECISION MACHINED and WEDGE-TIGHT

Materials for Victory start at the drafting board. Non-complicated designs that closely conform to simple principles such as the lever and the wheel are best.

Butterfly Valves have long been recognized as the ideal type for regulation. With the improved R-S design, they are now used with equal effectiveness for the *shut-off* of any medium that flows or is forced through a pipe. Manual or automatic operation in sizes to 84-inches and pressures to 300 lbs.

The new R-S Catalog No. 10-B tells the complete story. Write for your copy.

R-S PRODUCTS CORPORATION
4535 Germantown Avenue, Philadelphia, Pa.

VALVES FOR VICTORY

Fig. 3033

This Class 300-pound, 8-inch, Flanged End Angle Valve is one of a complete line of Cast Steel Valves designed and built by Powell especially for the power plants of today . . . and tomorrow. Anti-friction bearing yoke provides smoother, easier operation. New streamlined areas through the body make possible a minimum pressure drop. Details on request.

There's many a valve on a submarine, a cruiser, a battleship, or a freighter. There's many a valve in a powder plant, a refinery or a power plant. Wherever War Production is in full blast there are valves, and wherever new processes are being used which involve new treatment of the liquids and gases of Industry, new valve installations are being designed and built to handle them.

Twenty-four hours a day, seven days a week, Powell Engineers, Designers and Shopmen are devoting themselves to this task. Behind them is a century of experience, the skill which comes with it and a research engineering laboratory full of up-to-the-minute equipment. The builders of America's ships, refineries and arsenals will not forget Powell's contribution of Valves for Victory.

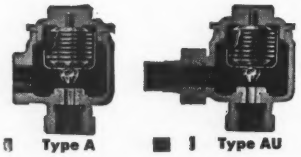
The Wm. Powell Company
Cincinnati, Ohio

POWELL VALVES

War Power to You!

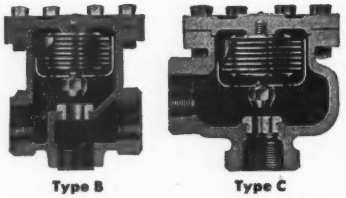
★

Maximum Efficiency with Minimum Maintenance *is assured users of*



Type A Type AU

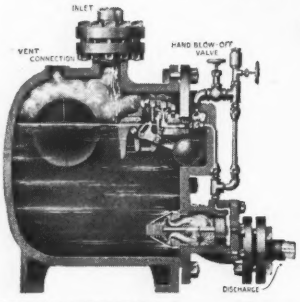
NICHOLSON *Traps*



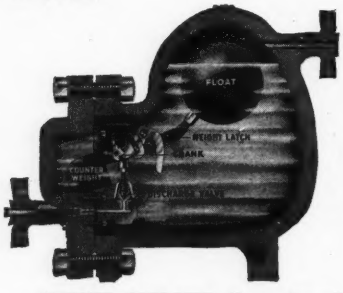
Type B Type C

INDUSTRIAL THERMOSTATIC Traps in 4 types for individual drainage of steam units in the "process" industries. Two to six times greater valve area and capacity than average traps of corresponding pipe size. No air-binding . . . no freeze-ups . . . no adjustment . . . no dribbling . . . no water-logged units. Sizes ¼" to 2". Pressures from vacuum to 300 lbs.

★



PISTON OPERATED Traps with non-collapsible float. Instantaneous positive action—no wire drawing. Extra large discharge valve. Pressures 2 to 650 lbs. at 750° max. temp.



WEIGHT OPERATED Traps for all pressures from vacuum to 1500 lbs. at 1000° max. temp. Large capacity, fully automatic, intermittent action. Thoroughly dependable.

★

EXPANSION Traps of continuous discharge type. Entirely automatic —easily adjusted for pressure up to 225 lbs.

SEE OUR CATALOG IN SWEET'S

WRITE FOR CATALOG NO. 941 and bulletins on Nicholson Control Valves, Floats, Compressed Air Traps, Air Separators, Flexible Couplings.

W. H. NICHOLSON & COMPANY
160 OREGON ST. WILKES-BARRE, PA.

Change of Address

To avoid missing an issue or paying for forwarding postage be sure to send a change of address to our office. Changes received by the 20th of the month can be made effective for following month's issue.

Appointment of H. C. Clement as assistant to the district manager of the New York district of General Electric Co., was recently announced by T. F. Barton, commercial vice-president.

Mr. Clement is a graduate of the University of Vermont and has been associated with General Electric since 1910.

Chas. G. Pyle, General Sales Manager of the Lighting Division of the Hygrade Sylvania Corp., has recently announced that R. F. Hartenstein, formerly Director of Lighting of the Ohio Edison Co., Akron, Ohio, has become associated with the Hygrade Sylvania Corp. as a special representative. Mr. Hartenstein will spend the major part of his time contacting the Commercial Departments of the various utilities throughout the United States. For the time being he will make his headquarters at the corporation's New York office.

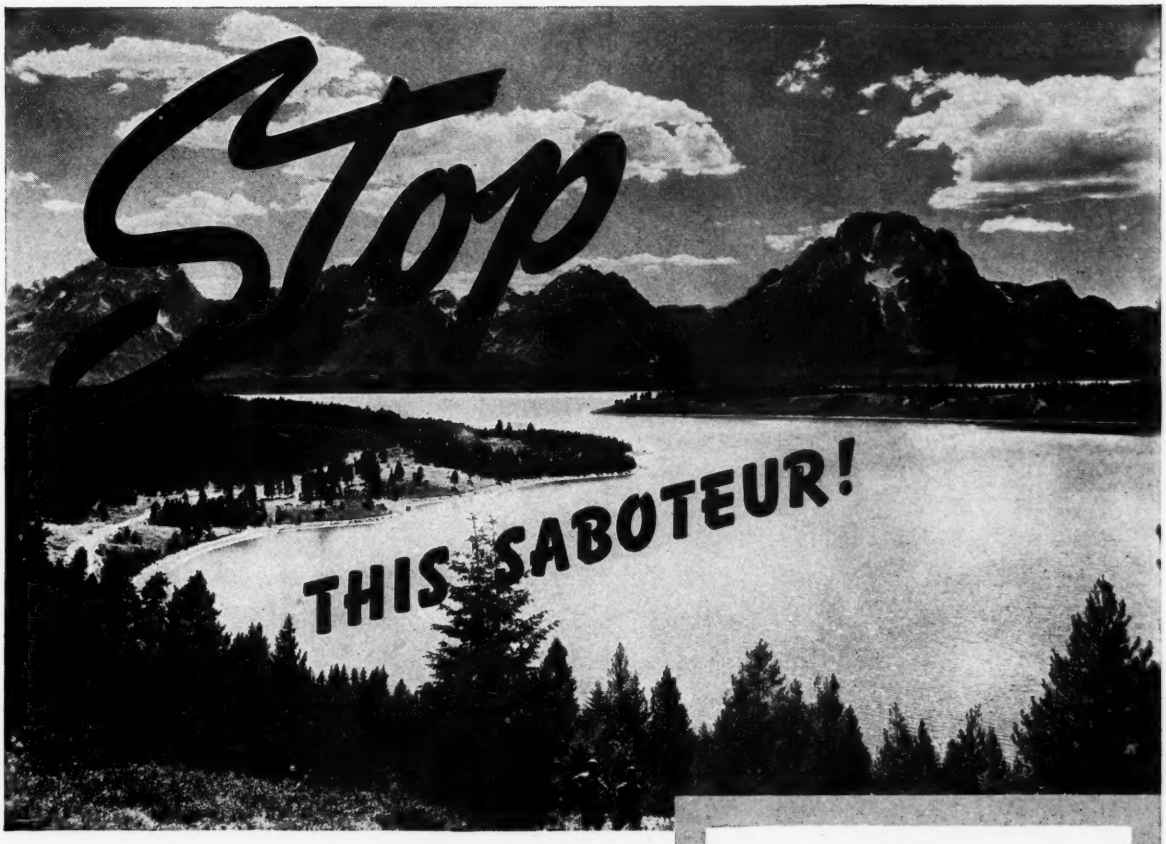
S. N. F. Hedman has been appointed designing engineer of the mechanical drive section of the turbine engineering department of General Electric's River Works, according to an announcement by works manager N. J. Darling. His period of continuous service with G. E. dates from July, 1925, following his graduation from the University of New Hampshire, when he was employed as a student in the instruments and meter department. Later he was transferred to the Thomson Research Laboratory, then to the compressor section of the turbine engineering department. In October, 1940, he was named assistant designing engineer of the mechanical drive section of the turbine engineering department, a post he held until his present advancement.

W. E. Corrigan, vice-president of American Locomotive Co., New York, since 1936 has assumed additional duties as head of Diesel engine sales. Diesel locomotive sales remain under the direction of Perry T. Egbert. Mr. Corrigan, who served as a captain in the artillery ordnance of the U. S. Army during the last war, has participated in negotiations on various recent contracts between the government and the American Locomotive Co. The company is making tanks, gun carriages, marine Diesel engines, shells, bombs and heavy forgings.

Consolidated Gas Elects Officers

HERBERT A. WAGNER, president of the Consolidated Gas, Light & Power Co., Baltimore, since 1915, and both president and chairman of the board since 1939, recently resigned as president and was later re-elected chairman of the board. Charles M. Cohn was elected president and William Schmidt, Jr., and Ralph Thomas vice-presidents.

Mr. Wagner supervised the building of the first incandescent lighting plant in St. Louis in 1899, organized in 1890 the Wagner Electric Mfg. Co., and served as first president, and was later a consulting engineer in the St. Louis territory. He went to Baltimore in 1908 to supervise the Consolidated's



Guards at every gate may protect your plant from human saboteurs. But what protection are you providing against other saboteurs . . . who enter your plant unchallenged through the water mains?

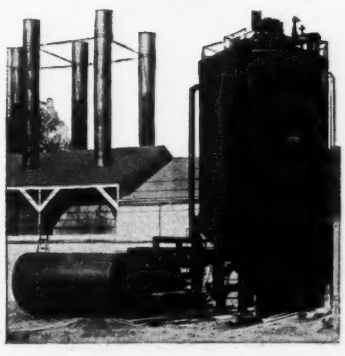
The innocent appearance of water may be a perfect disguise for saboteurs which can slowly, but surely, destroy vital parts of your power plant. Unless properly condltioned against scale, corrosion embrittlement, carry-over, etc., water can be as damaging to vital production as a bombing!

Infilco Equipment for boiler and evaporator feedwater treatment, cooling water conditioning, condensate oil removal, steam purification, etc. is engineered and built to the specific requirements of your plant by an organization of 48 years experience. Our complete facilities are at your service.

INFILCO
INCORPORATED

325 W. 25TH PLACE, CHICAGO, ILL.
Formerly **INTERNATIONAL FILTER CO.**

INFILCO



HOT-FLOW WATER SOFTENERS

The preferred method of modern boiler feed water treatment. Heats and treats make-up, heats condensate returns and deaerates both when deaeration is required. Send for Bulletin 1850.

INFILCO

ACCELATOR SOFTENERS • CATEXERS
CHEMICAL FEEDERS • CLARIFIERS • COOLING WATER CONDITIONERS
CONDENSATE FILTERS • HOT-FLOW SOFTENERS • LIME-SODA SOFTENERS
PROPORTIONERS • STEAM PURIFIERS • WATER FILTERS • ZEOLITE SOFTENERS

ROTO Saves Time

OUTSIDE AND INSIDE every tube you clean

Roto Model 135 air-driven motor with swing-frame head and air valve for one-man operation.

Faster, more effective action inside the tubes, and faster action between tubes. That's what the powerful new Roto Tube Cleaner equipped with a one-man operating air valve gives you. This time and labor-saving cleaner enables the operator quickly to turn the air on and off entirely by himself, not only eliminating a helper but also the inevitable signalling delays between every tube cleaned. Now, when increased power production is so vital and skilled help so scarce, every power plant engineer owes it to himself to write for details of the new time and labor-saving Roto.

SEE OUR ADV. IN SWEET'S

The ROTO Company

145 SUSSEX AVENUE, NEWARK, N. J.

Six Ways in Which Advertising Can Help Government and People

(1) Speed governmental accomplishment in the drive for victory . . . (2) Expedite conversion of industry to wartime production . . . (3) Ease the shock of war on civilian population and national economy . . . (4) Divert demand from scarce articles to those more plentiful . . . (5) Explain business to the public . . . (6) Condition markets for postwar developments.—G. D. Crain, Jr., Publisher of "Industrial Marketing"

electric division and served as a director and vice-president from 1910 until elected president in 1915. He served as president of N.E.L.A. in 1916 and is still active in the E.E.I., Association of Edison Companies and the A.I.E.E.

Ralph L. Thomas, who graduated from Princeton and later from M.I.T., was general superintendent of the Pennsylvania Water & Power Co. from 1915 to 1938, and project engineer of the Safe Harbor Water Power Co., since 1930. He has been executive engineer at Consolidated since 1938 and a director since 1939.

Dr. L. B. Miller with W. H. and L. D. Betz

Dr. L. B. Miller

Dr. Lewis B. Miller has joined the consulting staff of W. H. and L. D. Betz, Chemical Engineers, Philadelphia, Pa. Dr. Miller was graduated from the State University of Iowa with a Bachelor's and Master's degree and received his Doctorate from Columbia University. A member of committees D-19 of A.S.T.M. and Chairman of the water committee of T.A.P.P.I. he has engaged in research on problems relating to water purification and sewage disposal.

B. W. Clark Appointed Sales Head

B. W. Clark, vice president in charge of the Westinghouse Elec. and Mfg. Co.'s merchandising division, was recently appointed vice president in charge of sales. He will transfer his headquarters from Mansfield, Ohio, to Pittsburgh, Pa., and succeeds Ralph Kelly, who resigned to become executive vice president of the Baldwin Locomotive Works.

B. W. Clark

Mr. Clark, who is also president of the Westinghouse Electric Supply Co., attended the University of Michigan. He has been engaged in electrical wholesaling and merchandising for 35 yr. In 1906 he joined the Robertson-Cataract Electric Co. at Buffalo, N. Y., and in 1925 he became a special representative of the Westinghouse Electric Sup-

(Continued on Page 172)

why 10 REASONS you can bank on FAIRBANKS

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Insurance against valve failure and shut-down is of vital importance today in keeping production's wheels turning.

One way to guard against interrupted service is to use Fairbanks *Renewable* Valves, which are designed for quick and easy removal of worn parts and replacement with new. While parts require renewal only after long periods of service, the simple job of replacing them can be handled in a few minutes without removing valve from pipe line.

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9. **Backed by over 50 years' specialized experience.**
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as the **RIGHT VALVES TO USE**

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PILOT

That's the principle of the NULL BALANCE METHOD employed in the

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Friction-Free

FLOW METER

THE null or zero balance method consists in balancing the unknown quantity by adjusting a known quantity of the same kind, a highly sensitive detector being used to determine the point of balance.

A friction-free transmitter serves as the pilot for an external motor drive which restores the electrical bridge to balance and operates pen, indicator and integrator with high and equal power throughout the entire scale.

NOTE: A bridge circuit alone is *not* a null method meter. A galvanometer is required to detect unbalance and an external source of power is needed to restore balance. These are found ONLY in the Cochrane Electric Flow Meter.

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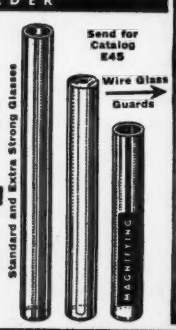

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Helpful Bulletins

BOILER PLANT EQUIPMENT

1 Baffle Walls—Bulletin B-40 tells how and why Enco streamlined baffle walls avoid eddy currents and eliminate dead gas pockets; help new and old boilers deliver more steam at lower cost. The Engineer Co.

2 Spreader Stokers—Helpful book on Iron Fireman pneumatic spreader stokers contains full descriptions, capacities, operating data, etc., with layouts and photos of 10 actual installations. It points the way to important fuel savings. Iron Fireman Mfg. Co.

3 Vibratory Cleaner — 6-page folder describes the Vibratap, a vibratory cleaner which removes scale by mechanical means which breaks the hold of the deposit on metal and is said to result in complete cleaning. Also illustrates Vibratap for both fire-tube and water-tube boilers. Brunt Equipment Co.

4 Coal Burners—New 8-page folder gives facts in detail on the Fyr-feeder which incorporates features of adjustable feeder, multiple pneumatic spreader, and control of coal distribution. Burns cheapest coal sizes and reduces coal bills. American Coal Burner Co.

5 Boiler Room Smoke Alarm—Engineering Bulletin No. 101 tells about the construction and application of the Worner photoelectric smoke alarm for boiler rooms. It not only prevents smoke ordinance violations but promotes fuel savings. Worner Products Corp.

6 Gas and Oil Burners—A 4-page illustrated Bulletin 203 describes Type A and Type H combined gas and oil burners. Construction features, performance and design are treated concisely. Peabody Engineering Corp.

7 Refractory Selector—Handy bulletin contains selector chart for choosing proper refractory for furnace doors, arches, baffles, ash pits, etc. Also provides color scale for temperature and other working data useful to boiler room and maintenance engineers. The Wahl Refractory Products Co.

8 Feed Water Heaters—Shown in 24-page Bulletin No. 110 are construction and operating advantages of Hoppes feed water heaters, deaerating, non-deaerating metering types. Also described is the Hoppes V-notch meter. The Hoppes Mfg. Co.

9 Integral Furnace Boiler—New Bulletin G34A gives complete data on integral furnace boiler, either stoker firing or oil burning. Can be quickly converted to burn whichever is the more economical fuel. Outstanding features of this unit are described in detail and cross sectional views show typical installations. The Babcock & Wilcox Co.

10 Stokers—44-page Booklet B-3039 describes continuous-ash-discharge stokers for central stations and industrial plants. Accurate construction, simplified control requirements, and installation economy among features listed. Photographs and line drawings illustrate combustion principles and typical installations. Westinghouse Elec. & Mfg. Co.

HELPFUL BULLETINS

Many useful engineering bulletins and catalogs are offered in the news and advertising pages of POWER PLANT ENGINEERING. For your convenience we publish the following summary of such literature mentioned in this and recent issues. To obtain copies of these bulletins and catalogs described simply indicate the paragraph numbers on the card below, detach and mail.

11 Tube Cleaners—Illustrated Bulletin P-14 describes Airetool tube cleaners, ranging from ½ in. to 20 in., I.D. Data should interest engineers desiring to save tubes, lessen fuel bills, avoid needless downtime. Airetool Manufacturing Co.

12 Packaged Steam Plant—Illustrated 12-page bulletin explains advantages of Oilbilt steam generating plant—a factory finished, packaged plant consisting of horizontal fire-tube boiler with special oil burner. Also contains specifications, typical installation photos. Cleaver-Brooks Co.

13 Single Retort Stoker—Helpful new Catalog No. 600 describes Detroit UniStoker, which is of single retort, plunger feed unit type. Sectional views show proper application with various types of boilers. Also provides figures on actual fuel savings reported by users. Detroit Stoker Co.

ELECTRICAL EQUIPMENT

14 Motor Generator Sets—New Bulletin 101-B tells about Ideal motor generator sets, high speed synchronous motors, switchboards, capacitors and other Ideal Electric equipment. The Ideal Electric and Manufacturing Co.

15 Electric Motor—Publication GEA-3580 presents many interesting highlights on the design, construction and application of G-E Tri-Clad electric motors. Gives full details about the extra protection features and other advantages. General Electric Co.

16 Distribution Systems—Dimensions, capacities and advantages of F-A Busduct distribution systems for electric light and power are described in Bulletin No. 61. Load center panelboards and circuit breakers in Bulletin No. 62. Frank Adams Electric Co.

17 Manual Auto-Starters—Low voltage starting of non-reversing, squirrel-cage, 2- and 3-phase, 5 to 200-hp. induction motors, manual autostarters are described in new 4-page Leaflet 10-7000. A tabulation lists recommended starter sizes for common horsepower and voltage ratings of motors used on 25, 40, 50 and 60-cycle circuits. Westinghouse Elec. & Mfg. Co.

18 Power Distribution — 16-page Booklet GEA-3758 explains basic principles of load-center power distribution for industrial, naval and military projects, shipyards, central stations, and commercial buildings. Also lists chief advantages of system, illustrates available circuit arrangements, and shows typical installations of load-center substations. General Electric Co.

FANS, PUMPS AND COMPRESSORS

19 Pump Handbook—"How To Choose a Blackmer Pump" contains much of the basic information needed for selecting pumps to handle various types of liquids. Many charts and reference tables for figuring capacity and head, friction losses, power requirements, etc. Blackmer Pump Co.

20 Valve Compressors — Feather Valve Compressors is the title of a 28-page Bulletin 1-675-B1. Fully illustrated, the catalog describes models for all types of industry and includes special lubrication information. Worthington Pump and Mach. Corp.

21 Stationary Compressors—Standard type compressors of the stationary type are discussed in a 12-page illustrated catalog that contains specifications and dimensions on belt driven and direct connection compressors. Schramm Inc.

22 Centrifugal Pumps — Features of Class GT 2-stage centrifugal pumps are described in new 12-page, 2-color Bulletin 7167. Contains photographs and cross-sectional views, extensive performance tables, a comprehensive tabulation showing friction of water in various sizes of pipe, describes many structural details of the pumps, and cites its applications to many industrial organizations. Ingersoll-Rand Co.

23 Pumps — A 36-page Catalog B-6018-B gives a compilation on SS Unit pumps and electrifugals with capacities up to 2750 g.p.m., in sizes 1 in. by ¾ in. to 8 in. by 6 in. Included are illustrations of varied applications. Allis-Chalmers Mfg. Co.

INSTRUMENTS AND CONTROLS

24 Hand Tachometer—Bulletin 1710 describes the Jones Heavy Duty Hand Tachometer, an indicating instrument for measuring speed directly in r.p.m. and f.p.m. James G. Biddle Co.

25 Pressure Reducing and Desuperheating—Bulletin No. 111-41 is an installation report, illustrated with photos and large diagrams, on the pressure reducing and desuperheating system as installed at the new power plant of Jacob Ruppert Brewery, New York City, to co-ordinate the operations of the steam turbines and the various steam pressure systems in the plant. Republic Flow Meters Co.

26 Water Controls — Bulletins have been issued dealing with Squires Automatic Boiler Feedwater Controller, Class B Excess Pump Governor and Air Traps. These devices are fully described, their applications and sizes are given. The C. E. Squires Co.

27 Combustion Control — A 20-page booklet entitled Automatic Combustion Control and Its Relation to Lower Steam Costs explains the functions of automatic combustion control and how it reduces operating costs in the boiler room. Schematic drawings show applications to various types of fuel feeding equipment and with different kinds of fuel. The Hays Corp.

28 Potentiometer Indicators — New Bulletin A-305 describes complete line of Foxboro potentiometer temperature indicators and indicating resistance thermometers. Instruments include single-point and multiple-point models, models equipped with selective key-switches for as many as 82 contact points, as well as the popular portable models. Constructional features and a list of standard ranges are also given. The Foxboro Co.

29 Pressure Reducing Orifice—Multiple pressure reducing orifice for service in boiler feed bypass is described in a recently released 4-page bulletin. Ratings, weights and dimensions are included with an explanation on the arrangement and purpose of bypass. Worthington Pump & Mach. Corp.

30 Temperature Control — A control system which is said to be enabling many steam plants to run superheated steam right up to the top safe limit, and to hold it there steadily, is described in 16-page Catalog N-33-163(1) dealing with the Micromax Electric Control. Schematic diagrams and reproductions of chart records illustrate the operating results. Leeds & Northrup Co.

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31 Combustion Control Regulators—Bulletin 15 describes electrically actuated combustion control regulators and systems. Small boiler installation is discussed and information is outlined on the electric eye system. Brooke Engineering Co., Inc.

32 Meters and Controls—Bulletin No. 16, entitled How to Stretch Steaming Capacity Successfully, contains a check list of procedure for boiler room improvement, with explanations as to how the proper use of metering and control equipment stretches steam capacity, avoids frequent shut-downs for maintenance, insures safety of men and equipment, furnishes data for comparison of fuels, reduces fuel consumption, and maintains efficiency while new operating crews are being trained. Bailey Meter Co.

33 Boiler Level Controllers—A new bulletin illustrates and describes two improved types of boiler level controllers, pilot operated and rotary. Both are designed on the cantilever principle which permits wider range of movement for valve motivation and use of a smaller valve. J. A. Campbell Co.

34 Wide Range Flow Meter—Catalog No. 2007 pictures and explains the operating advantages of the Brown Wide Range Meter System. It consists of two meters connected to same orifice; is said to fulfill every requirement for high pressure heating and process loads. Brown Instrument Co.

35 Equipment Control—New 28-page book describes Williams pump valves — water gauges — steam pump governors—gauge cocks, ball type high pressure steam traps—safety feed water regulators—columns, high and low alarm—flanged noiseless check valves—standard feed water regulators. Also pictures many plants in which these products have been installed. The Williams Gauge Co.

36 Magnetic Crane Control—Booklet 930 describes two new systems of control for ac cranes—EC&M Dynamic Lowering Control and Contra-Torque Lowering Control. Through the use of frequency relay, these systems make possible new crane speeds and simplicity of operation. The Electric Controller & Mfg. Co.

MECHANICAL TRANSMISSION

37 V-Belt Drive—How to increase flexibility in machines with quick, accurate speed changing is dealt with in new Bulletin B6082-A. Stationary and motion control sheaves are described, and operating diagrams, sizes and dimensions are included. Allis-Chalmers Mfg. Co.

38 Gears—Developed to handle high speeds and powers associated with steam turbine installations, these gears are engineered to suit the installation. Have been used successfully in connection with turbines, high speed centrifugal compressors, etc. Full details are given in Bulletin S-130. The Terry Steam Turbine Co.

39 Power Transmission Equipment—Catalog D-30-Jr. 6th Edition contains 91 pages of interesting data on a line of equipment that rules out waste and leakage between the source of power and the driven machine-bearings, clutches, couplings, sheaves, pulleys, V-belts, etc. More than a catalog, a copy of this interesting booklet should be in every power engineer's library. Dodge Mfg. Co.

40 Belting — How to Make Your Belts Last Longer is the topic treated in an illustrated booklet that contains helpful reference data and formulae. Correct installation methods and practical suggestions are included. E. F. Houghton Co.

41 Air Conditioning Drives — Motor drives, gearing, and control for industrial and commercial air conditioning systems are described in new 32-page Bulletin B-3044 that also discusses reasons for motor dependability. Views of typical commercial installations are included. Westinghouse Elec. & Mfg. Co.

42 Wire Rope Manual — Well illustrated 82-page book, Know Your Ropes, provides a helpful handbook on the selection, application and usage of wire rope. Contains many diagrams for splicing and attaching; also ideas for conserving the strength and life of wire rope. A valuable reference book for engineers and maintenance men. Wickwire Spencer Steel Co.

43 Motor Drive Selector—A pocket size celluloid slide rule selector SA 714 for electricians, plant maintenance men and others interested in the selection of electric drive equipment has recently been designed as an easy guide in the selection of the proper type of motor for 44 industrial applications. Information is obtained by setting the cardboard slide for the proper motor type and then reading its specifications through the window in the acetate envelope. Pertinent facts such as horsepower ratings, speeds, voltages, frequencies, and starting and pullout torques are thus secured. The reverse side of the selector shows which of the various magnetic and manual controls are available for each type of motor and lists the proper control number. Westinghouse Elec. & Mfg. Co.

PIPING, VALVES AND FITTINGS

44 Valves and Gauges — A supplementary 36-page 2 colored Catalog No. 600, fully illustrated, covers valves and gauges, and supplies engineering data as well as specifications. Capacity tables of the equipment are also included. J. E. Lonergan Co.

45 Flexible Metal Hose—Eclipse Aviation-Bendix Bulletin No. H-201 gives complete information about Eclipse Aviation Seamless Flexible Metal Hose, widely used for handling alcohol, grease, hot liquids, oil, steam and other non-solids, where high temperature and pressures prevail, and where flexing and vibration are encountered. Eclipse Aviation (Metal Hose Department) Division of Bendix Aviation Corp.

46 Data Book on Welding Fittings—Full of technical and other interesting data, Catalog 109 describes the complete Tube-Turns line of 90 deg., 45 deg. and 180 deg. seamless welding fittings, tees, reducers, heads, nipples, laterals, and flanges. Constructed to have true uniformity of wall thickness, these fittings can be lined up easily and correctly to match the pipe in both OD and ID. Tube-Turns, Inc.

47 Steam Hook-Ups — Recently released is a new 42-page book of engineering data on selecting, sizing, and installing steam traps, temperature regulators, water mixing valves, and heating system specialties with 75 hookup sketches of correct steam piping for all types of industrial and heating equipment. Sarco Co., Inc.

48 Valve Reseating Machines—New Catalog 40—32 pages—offers complete explanation of construction and operation of valve reseating machines for either gate, globe and pump valves. Easily operated, reliable, efficient and durable, these machines save valves from discard many times. The Leavitt Machine Co.

49 Steam Trap Handbook — How do you size traps? An easy method, plus valuable information on the installation and maintenance of steam traps is given in Catalog 63. The Strong, Carlisle & Hammond Co.

50 Fire Protection Valves—Quick operating valves for fire protection, vital for plants in war production, are described in illustrated Bulletin E-52B which also contains dimensions, specifications and recommendations for installation. The valves are for emergency shut-off or diversion of the flow of inflammable liquids, or for the diversion or concentration of water to sprinkler or water curtain systems. Everlasting Valve Co.

51 Air Shut-Off Valves—Small folder shows many operating advantages of Homestead-Ross air shut-off valves as used on lines to air guns, chipping hammers, drills and other air-operated tools. Table tells cost of air leaks. Homestead Valve Mfg. Co.

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52 Underground Conduit Systems—Catalog No. 41 contains complete data on all approved types of construction on underground conduit systems for steam and hot-water lines, with special emphasis on Ric-Wil presealed insulated pipe units. These factory-built systems are delivered ready for installation. Ric-Wil Co.

53 Pipe Line Strainers—New bulletin explains how Yarway fine-screen strainers keep dirt from steam traps and other pipe line equipment. Prices, weights, dimensions, application data. Yarnall-Waring Co.

54 Flexible Piping—New 8-page Bulletin 71 furnishes 1942 standard data for Penflex, all-metal flexible pipes for Diesel installations, exhaust pipes, air intakes and supply lines. Pennsylvania Flexible Metallic Tubing Co.

55 "How to Choose a Steam Trap" is the title of a new convenient informative steam drainage guide, 40 pages of condensation rate charts, graphs, tables—formulas for computing condensing capacity of steam using equipment—trap sizes for unit heaters, header drips, jacketed kettles, etc., will give you all the data the title of this book infers. The V. D. Anderson Co.

PRIME MOVERS

56 Diesel Engine Lubrication—A 16-page booklet by that name stresses importance of correct lubrication from maintenance and operating standpoint. Recommendation chart shows proper grades of principal brands of this company's Diesel engine oils, listed in accordance with engine builder's specifications. Cities Service Oil Co.

57 Turbine Water Wheels — Handy pocket edition of Bulletin 36 shows many interesting applications of Leffel vertical and horizontal turbine water wheels. Also pictures head gate and waste hoists, trash racks and related equipment. The James Leffel & Co.

58 Diesel Engines — Attractive 16-page Bulletin 138 covers 9x12 in. Superior stationary Diesel engines which can be converted into gas engines. Also contains diagrams of engines and principal parts as well as installation photographs. National Supply Co., Superior Engine Div.

59 Steam Turbines — 6-page Bulletin No. 1951 illustrates the special features of types GA & GB steam turbines with combined reduction gears. Also contains photographs of typical installations. Moore Steam Turbine Div.

60 Electric Plants—Fully automatic, compact and economical, the Kohler electric generating plants are described in recent bulletin. These units are widely used in civilian and government service to light night construction, serve air fields, factories, army camps, etc. Capacities up to 10 kw. Kohler of Kohler.

WATER TREATMENT

61 Chemical Feeders—Illustrated bulletin explains applications of Pulsafeeder for accurate feeding of corrosive and non-corrosive chemical solutions. Adapted to proportioning problems of corrosion control, water conditioning, pH control, boiler feed, etc. Wilson Chemical Feeders, Inc.

(Continued on Page 168)

ON GUARD... Against POWER LOSS —a Saboteur of Production

VICTORY on far-flung battle fronts begins with the will-to-win at home . . . in mine, mill or factory . . . with every turn of shaft, wheel, or gear . . . with positive assurance of high speed, continuous production.

Power transmission — the vital link between the machine and the source of energy that gives it productive capacity — must be uninterrupted . . . free of waste, power leakage, time-consuming breakdowns . . . other "saboteurs" of production. Dodge-Timken Rolling Bearings are one of many classes of Dodge products that provide a quick, sure, and economical answer to many important power transmission problems. High speeds . . . shock loads . . . heavy, medium and light duty . . . dust . . . water . . . heat . . . all these and many more strenuous service conditions are fully met in the Dodge 30,000-hour line of bearings.

For the most efficient methods in production or power transmission and application . . . depend on Dodge . . . its engineering experience . . . its nation-wide distribution . . . "Depend on Dodge for *the right drive for every job.*"

DODGE MANUFACTURING CORPORATION, *Mishawaka, Indiana, U. S. A*

PRACTICAL SUBSTITUTES FOR *Tin Base* BABBITTS

Magnolia has developed two new lead-base bearing metals which effectively "pinch hit" for tin-base babbitts. These, together with Magnolia Anti-friction Metal, fill practically all bearing metal requirements.

- **MAGNOLIA Anti-friction METAL** for steady, high speeds and uniform loads.
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New Bulletin giving full details, specifications on all Magnolia Metals sent free on request.

MAGNOLIA METAL CO. • ELIZABETH, N. J.

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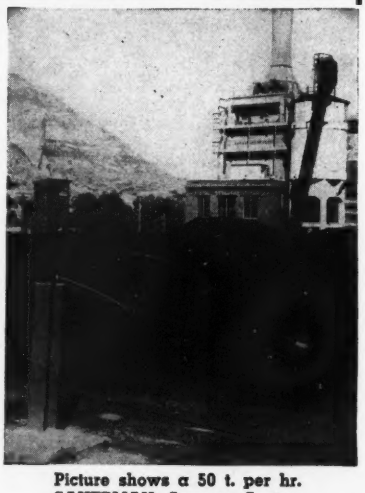
Store and Reclaim Coal for few cents per ton.....



Picture shows a 50 t. per hr. SAUERMAN Scraper System

SAUERMAN Scrapers are on record as handling coal for less than 2c per ton at large power plants and for only slightly more at small plants.

This operating economy is just one of many reasons why SAUERMAN Scrapers have become the most widely used equipment for open storage of coal. Among other reasons are the following:

- **Machine is simple and easy to operate. From a station overlooking the storage area the operator controls every move of the scraper through a set of automatic controls.**
- **The equipment is adaptable to any ground space regardless of the shape or condition of the area.**
- **Scraper piles coal in compact layers. There is no segregation of lumps and fines; no air pockets to promote spontaneous combustion.**
- **Each SAUERMAN installation is a permanent, trouble-free investment. Maintenance cost is negligible.**

If you have any problem of storing coal, it will pay you to investigate this economical, flexible scraper system. Write today for catalog which gives details on equipment layouts for coal storage projects of every size.

SAUERMAN BROS., Inc.
586 S. Clinton St. Chicago, Illinois

62 Algae Control—Algae control becomes of considerable interest at this time of the year in many parts of the country. The elimination of algae and slime in cooling systems is discussed in Nalco Bulletin No. 31 issued by the National Aluminate Corp. and will be sent free to engineers who ask for it.

63 Water Treatment—The Why and How of Water Analysis is the title of a 20-page illustrated booklet furnishing complete information on water testing equipment, methods for making control tests, conductivity apparatus, proportioning pumps and chemical feeders. Bird-Archer Co.

64 Boiler Metal Treatment—Booklet 101 tells you how you can reduce boiler maintenance costs bv the use of Brooks boiler metal treatment, Alumina water conditioners, soot and carbon remover, etc. The Brooks Oil Co.

65 Zeolite Softeners—How to guard against needless boiler cleanings is explained in Bulletin 307 which covers Graver zeolite water softeners and six types of Graver zeolites. Contains a series of interesting flow diagrams for waters of different characteristics. Graver Tank & Mfg. Co., Inc.

66 Boiler Scale Problems—An 18-page Bulletin, "Solving the Boiler Scale Problem with Sand Banum," tells how boiler and engine scale and corrosion are controlled easily and economically. The data applies to water treatment in processing industries as well as to general power plants. American Sand-Banum Co.

67 Water Conditioning System—New Technical Water Conditioning System is described in a bulletin free for the asking. Specific organic formulas developed individually to fit your needs. Company engineer will inspect your plant without obligation. Water Treatment Co. of America.

MISCELLANEOUS

68 Diesel Noise Control—Data book describes design, application, as well as accomplishments of Burgess exhaust snubbers for reducing noise nuisance in Diesel exhaust without increasing fuel consumption. Burgess Battery Co.

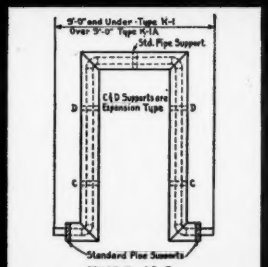
69 Quick Floor Patch—Described in a helpful bulletin just issued is Instant-Use Resurfacer, a Flexrock product for patching ruts and holes in all kinds of industrial floors. Advantages include: no mixing, no waiting, no traffic tie-ups. Flexrock Co.

70 Heat Insulations—52-page book, GI-6A, contains recommendations on high- and low-temperature insulation for industrial needs from 400 F. below zero to 2500 F. above. Complete data also included on J-M refractory products. Johns-Manville.

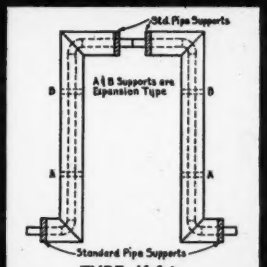
71 Electroforged Steel Grating — Send for free paper weight size sample to visualize the advantages offered by this grating. Easily maintained, comfortable and economical. Completely described in Catalog 1526. Power Piping Div. of Blaw-Knox Co.

72 Oil Purifiers—Bulletin No. 100M provides useful engineering data and specification for Honan-Crane oil purifier for gas or Diesel industrial engines. Bulletin 300T deals with steam turbine lubricating oils and Bulletin 400F with Diesel fuels. Honan-Crane Corp.

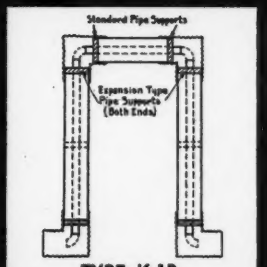
(Continued on Page 170)



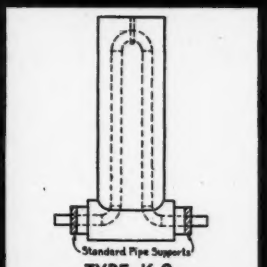
TYPE K-1
1-piece completely factory assembled U-Bend.



TYPE K-1A
2-piece U-Bend (2-Z-Bends) for connection in the field.



TYPE K-1B
3-piece U-Bend for field assembly (split conduit elbows furnished).



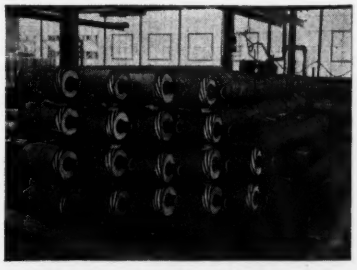
TYPE K-2
Hair Pin Type Expansion Loop completely pre-fabricated.

★ PRE-FABRICATED EXPANSION LOOPS ★

FOR YOUR STEAM OR HOT WATER LINES

Slip elbows to form U-Bend expansion fittings on the job. Type K-1B

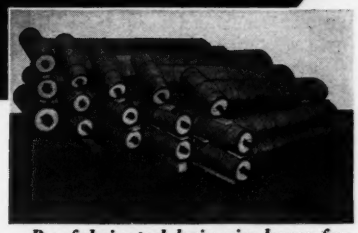
Nested expansion U-Bends for main and return lines. Type K-1A and K-1



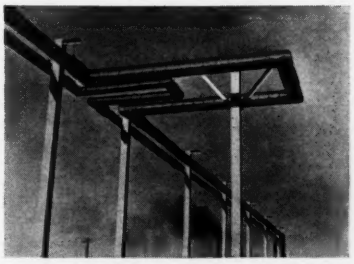
Halves of large U-Bends fabricated for field assembly. Type K-1A

Speed is imperative on steam and hot water lines vital to the war program. Don't stay on the defensive, waiting for material to complete your war construction contracts. GET ON THE OFFENSIVE by using Ric-wiL pre-fabricated expansion U-Bends or Loops! They are furnished, in choice of types shown, for any kind of service—underground or overhead, inside or outside lines. Correctly engineered per your plans and specifications, including insulation. Precision-made under controlled factory conditions. Conduit tested for air-tightness and pipe hydrostatically pressure-tested to code requirements. Shipped to the job *ready to install.* Built for strength and safety. No flanges to tighten—no gland packing or gaskets—no maintenance—no danger from leakage. Write for new Data Charts on expansion loop calculation for various conditions.

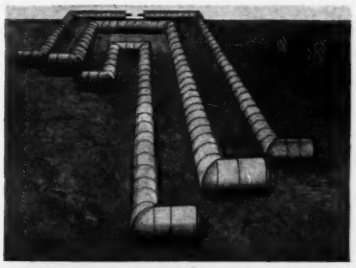
If you will furnish sketch showing conditions, pipe sizes and amount of expansion needed (or temperature of line and distance between anchors)—we will give you detail dimensions and prices.



Pre-fabricated hair pin loops for flange welded units. Type K-2



Overhead steam and return lines with expansion bends. Type K-1A

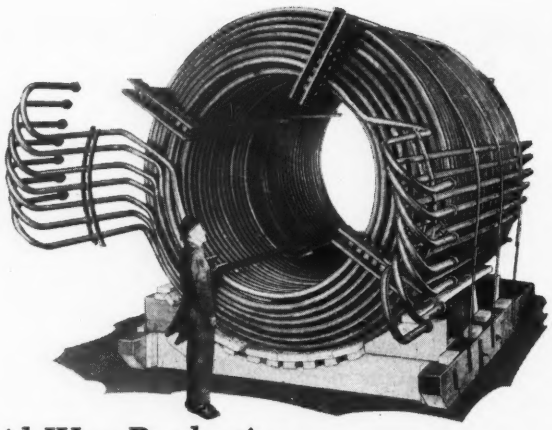


Z-Bends (K-1A) and U-Bends (K-1) with offset ready to weld into line.

RIC-WIL

CONDUIT SYSTEMS FOR UNDERGROUND STEAM

THE RIC-WIL COMPANY • CLEVELAND, OHIO
AGENTS IN PRINCIPAL CITIES



To Aid War Production—

A 1¾ MILE NESTED SPIRAL COIL

Typical of the way in which Rempe engineering and production facilities are contributing to the war effort is this giant multiple spiral coil recently delivered to a machinery fabrication plant.

Built of Grade A-106 seamless steel pipe, with seven separate circuits, this large heating coil contains more than 1¾ miles of pipe and weighs 22,000 lb.

Rempe Coils and Bends are made from any material to customer's specifications —are widely favored by engineers for Heat Exchangers, Feed Water Heaters, Coils for Refrigeration Machines, Chemical Processes, etc. Write for estimates.

REMPE CO.

342 No. Sacramento Blvd., Chicago

what WE READ in WATER

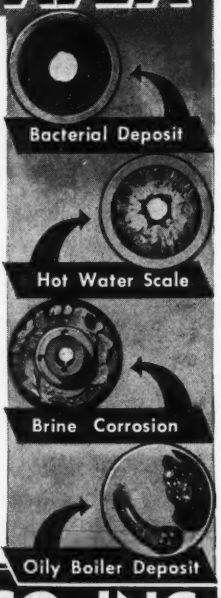
There are a great many stories that can be read in the various samples of water we receive. They tell of scale and corrosion in varying degrees of destructiveness. Water for cooling systems, steam and return systems, refrigerating brines . . . each has its particular story. Power plants, petroleum industries, process industries, public buildings and transportation industries . . . all have their problems.

Let us study these problems for you and tell you how Chrom Glucosate, Phospo Glucosate, and many others of our Haering products can correct these conditions, saving your materials and increasing the production of your plant.

Write for these interesting booklets:

"Organic Methods of Scale & Corrosion Control"
"Cooling Waters" • "H-O-H Lighthouse Reprints'
"The Solution of Your Proportioning Problem"

and other booklets on water treatment for Power Plants, Refrigeration Plants, Petroleum Industries, Process Industries, Public Buildings, and Transportation Industries.



D. W. HAERING & CO., INC.

GENERAL OFFICES: 205 West Wacker Drive
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73 Repair Handbook & Metal Protractor—A 40-page guide to the use of Smooth-On cements contains 170 diagrams and instructions for making lasting and economical repairs to plant equipment, pipe lines, fixtures, etc. Free, useful protractor is also yours for the asking. Smooth-On Mfg. Co.

74 Control of Air Moisture—New literature give application and operating data on the Kathabar system for controlling air moisture accurately, automatically, economically. Valuable reference data for engineers in processing industries. Surface Combustion.

75 Coal Crushers—These descriptive bulletins on crushers will be of interest to engineers desiring better coal sizing, improved boiler performance. Bradford breakers, Bulletins No. 3005 and 3004; Hammermills, No. 1030; Bradford-Hammermills, No. 7001; Single Rolls, No. 2006; Granulators, No. 9000. Pennsylvania Crusher Co.

76 Indicating Devices—Flow Indicating Devices and To Help You Win The War of Production are the titles of two timely booklets issued by S. F. Bowser & Co. They contain valuable data on the handling of oil and other liquids in industry.

77 Conveyor Handbook — Engineers will find new 124-page Catalog No. 200 a valuable handbook on elevating and conveying operations in all industries. Shows how standard and special conveyor designs can be combined to meet specific requirements. Gifford-Wood Co.

78 Compressed Air Purifier—Bulletin contains interesting data and complete description of "Type T" compressed air purifier. Delivers clean, dry, compressed air. Especially suitable for compressed air tools, paint sprayers, air blasts and air operated equipment. Wright Austin Co.

79 High Pressure Return System—Bulletin describes Cochrane-Becker high pressure condensate return system. Insures thorough condensate and air removal from process apparatus, making increased production and fuel savings possible. Cochrane Corp.

80 Manual on Air Circulation — A handy file folder holding two new catalogs on controlled air circulation and roof ventilators is a comprehensive manual on the two subjects. Instruction is also given on ventilator installations for standard and special types of roofs. The Swartwout Co.

81 Pulverized Coal — 8-page bulletin traces development of pulverized coal since first patent in England in 1831; also provides useful information about modern coal burning methods, construction details, application, operating economies of Sims-Pettibone unit pulverizers. The Sims Co.

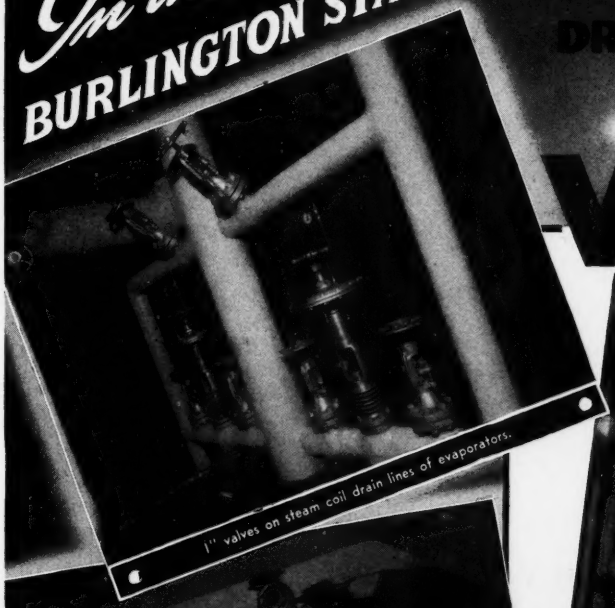
82 Methods of Precision Cleaning—Literature is now available covering the subject of cleaning instruments, meters, gages and related precision mechanisms. Cleaning and rinsing solutions are recommended, and methods for doing the job are shown. L & R Manufacturing Co.

83 Refrigeration Air Purger—Bulletin describing the automatic Armstrong purger for commercial and industrial refrigeration systems now available. Gives data showing amount of power saved by reducing head pressure, also helpful information on how to reduce amount of gas lost in purging. Armstrong Machine Works.

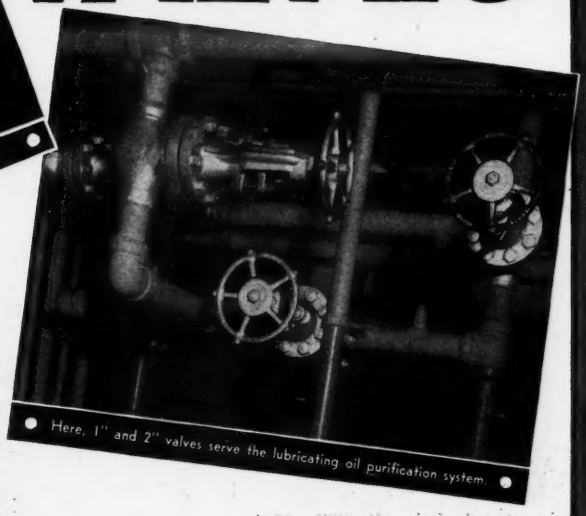
In the line at BURLINGTON STATION

Vogt

DROP FORGED STEEL *Steam* VALVES

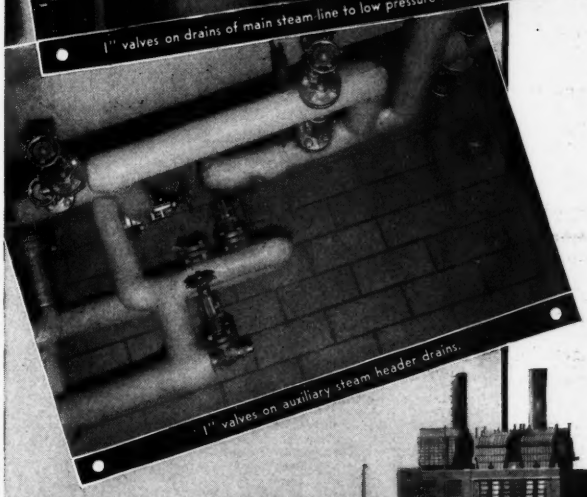


1" valves on steam coil drain lines of evaporators.



Here, 1" and 2" valves serve the lubricating oil purification system.

1" valves on drains of main steam line to low pressure turbines.



1" valves on auxiliary steam header drains.

Unit No. 5 at the Burlington Generating Station of the Public Service Electric and Gas Company has recently been placed in service. It consists of two 550,000 lb.-per-hour boilers which supply steam at 1,250 lb. and 950 deg. F., a 125,000-kw. condensing turbine-generator operating at 3,600 rpm., and the necessary auxiliary equipment.

Vogt *drop forged steel* socket weld end valves, as illustrated here, play an important part in the smooth, dependable functioning of this modern power plant.

Catalog F-8 sent upon request.

HENRY VOGT MACHINE COMPANY

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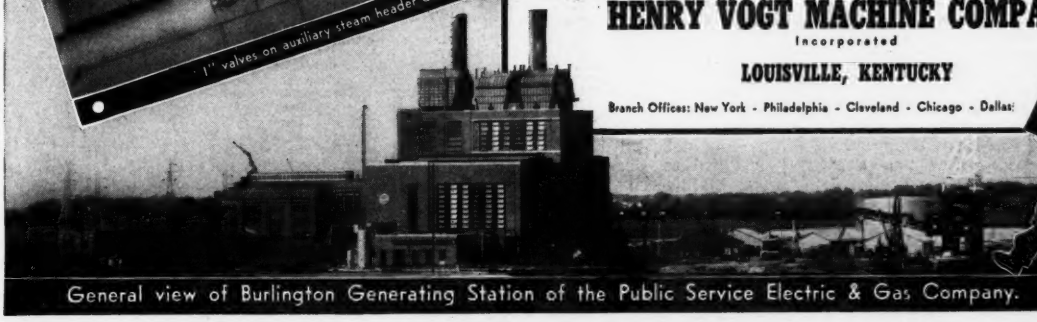
Branch Offices: New York - Philadelphia - Cleveland - Chicago - Dallas



General view of Burlington Generating Station of the Public Service Electric & Gas Company.

"BEST STOKER BUILT"

HUNDREDS of users of the "up-to-the-minute" *multiple* FYR-FEEDER praise the EFFICIENT, DEPENDABLE, ECONOMICAL service they have been getting ever since changing over to this *most* modern firing system. Engineers say it's the best and finest stoker built and you will agree with them if you install it under your boilers.

Why go on with "out-of-date" firing methods when you can have the Multiple FYR-FEEDER Spreader Stoker do a wonderful job for you?

- **Simple, automatic, foolproof! BURNS COAL LIKE OIL!**
- **FYR-FEEDER means less work for the fireman. Makes firing automatic and E-A-S-Y! Takes all the hard work out of cleaning fires—no clinkers to struggle with—no slice bars need be used.**
- **FYR-FEEDER increases boiler steaming capacity. FYR-FEEDER burns cheapest coal at highest efficiency. FYR-FEEDER uses local coals and saves VITAL transportation facilities now so urgently needed in the War effort. FYR-FEEDER reduces smoke because it produces accelerated or "instant" and perfect combustion.**

FYR-FEEDER does a perfect firing job with a thin fuel bed—with never more than an average of a half inch of coal on the grate.

FYR-FEEDER will help you cut your steam costs.

Wire your order for FYR-FEEDER today, or write today for full details.

TERRITORIES FOR SALES ENGINEERS

Some territories are open for experienced sales engineers familiar with steam plant boilers and furnaces. Information on request. Please furnish record of your experience and references.

AMERICAN COAL BURNER COMPANY, ENGINEERS
22-18 East Erie St., Chicago, Ill.

☐ **YES, I want to know what the FYR-FEEDER can do in our plant.**
☐ **Please mail descriptive literature.**
☐ **I am interested in selling FYR-FEEDERS.**

Name.....
Company.....
Address.....

ply Co. and 4 yr. later he was made general manager. In 1932 he was made vice president and director, and later was elected president of the Supply Company.

Mr. Clark was elected vice president of the Westinghouse Elec. and Mfg. Co. in January, 1941, heading its merchandising activities.

Heads Merchandising at Westinghouse

JOHN H. ASHBAUGH, manager of manufacturing and engineering of Westinghouse Elec. and Mfg. Co.'s merchandising division, was appointed manager of that division with headquarters in Mansfield, Ohio.

Prior to his appointment as manager of manufacturing and engineering of the merchandising division last fall, Mr. Ashbaugh had been acting manager of those activities in the Westinghouse plants at Mansfield and Springfield, Mass., since January, 1941.

J. H. Ashbaugh

Starting with Westinghouse in 1918 as a student engineer in the East Pittsburgh Works, he was assigned to the Company's activities in the comparatively new field of instruments for aircraft wireless sets 2 mo. later. He then worked on meters and relays and soon became section engineer in the automatic regulator section, where he developed voltage control apparatus for power houses and industrial applications.

Mr. Ashbaugh was transferred to the merchandising division in 1931, as assistant manager of engineering at the Springfield works, and later was named manager of engineering at the works.

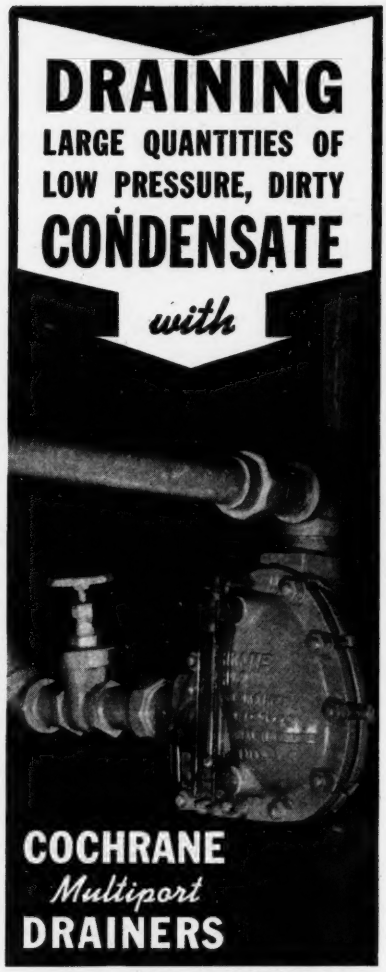
James A. Cranston

JAMES A. CRANSTON, 80, who retired as commericial vice-president of General Electric Co. in 1938, after 49 yr. in the electric field on the West coast, died at his San Francisco home on April 15.

His original contacts in the Northwest in the electrical field began with the Thomson-Houston Co., St. Paul, Minn., and in the course of his career he worked with groups and civic leaders to establish power companies, erect power lines and install equipment.

In 1892 his original company became part of General Electric and he was assigned to Portland, Oregon, and it was at this time that the lumber, mining, and shipping industries were largely developed through electrification.

In 1923 after 31 yr. in the Northwest, his headquarters were moved to San Francisco.



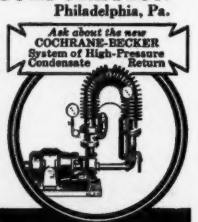
at S. D. WARREN CO.'s
Cumberland Mills, Maine
• PAPER MILL •

MANY Cochrane Multiport Drainers are in use at the Warren Cumberland Mills plant as they are in many other paper mills. The reason for their satisfactory operation is told by Mr. F. L. Wellcome, steam engineer at this plant: "These traps discharge continuously, the valve opening being determined by the height of water in the float chamber; the larger the volume of water, the larger the valve opening. The rotating movement of the sleeve valve serves to keep the valve free of sludge accumulation."

Write for Publication 2925 on Multiport Drainers

COCHRANE CORPORATION
3123 N. 17th St. Philadelphia, Pa.

Rapidly removes hot condensate from steam process equipment and returns it to boiler at high pressure and close-to-process temperature. IMPROVESQUALITY, INCREASES PRODUCTION, CUTS COSTS.



Cochrane

MORE THAN 2 YEARS ON THE JOB — NO TROUBLE

"'1000' valves have regulated perfectly since they were installed over two years ago. We have never opened them up."
—Case No. 177

Three Years Remarkable Service

"The first Streamlined Valves we bought from you have been in about three years — we have had no trouble whatsoever. This service is remarkable."
—Case No. 179

4 YEARS ON THE LINE

"Our first '1000' valve has never been out of the line in four years. We adjust it constantly for different pressures and it stays put."
—Case No. 135

4 YEARS SERVICE AND STILL GOING

"We have dozens of these Streamline Regulators in use, yet over a four-year period we have not spent one dime for repair parts."
—Case No. 143

After 18 months . . . seat and ring show no wear . . .

"As far as maintenance is concerned, we put them in and forget about them — they really control the pressure."
—Case No. 309

5 YEARS WITHOUT SERVICE ATTENTION

"We had to have capacity and close regulation—we got all that and more — this valve has given excellent service—no repairs needed in five years."
—Case No. 325

CASH STANDARD *Streamlined* TYPE 1000 PRESSURE REDUCING VALVE

• The Aspirator (circled in "1000" illustration above) gets the inner valve wide open to meet the demand and hold delivery pressure constant.

• Straight path for the fluid through the flow tube—gives you better pressure control and greater capacity.

• Streamlined flow around the inner valve—eliminates turbulence—thereby gives you best control under varying loads.

GIVES THIS FLOW PATTERN
The Streamlined form of the inner valve eliminates turbulence. It produces the flow pattern shown above which makes for maximum capacity when it is needed most, and permits accurate pressure control under toughest working conditions.

★ **Accurate, reliable pressure reduction service for steam, air, oil—most anything that flows — at definite cost savings. That is what you can expect from a CASH STANDARD Streamlined Reducing Valve. In addition you have the following points that you can definitely figure on — smooth operation — elimination of failures and spoilage — speedier production — and an end to worry and bother. Years of service in a wide variety of installations show that users of the "1000" valve do get all of these benefits. Sizes ¼" to 2" screwed ends.**

• *Send for Bulletin 1000—it gives you the complete story.*

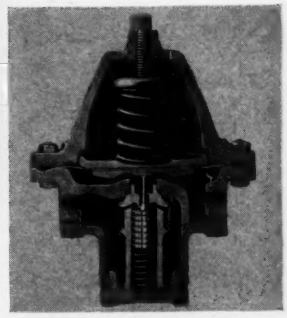
A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD CONTROLS .. VALVES

A CASH STANDARD "GET ACQUAINTED" COLUMN

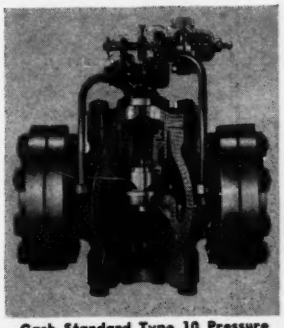
Question: **"Don't you people make anything besides that Streamlined Valve you talk about so much?"**

Answer: **"Yes Sir; we do! And we propose to picture one or two of them here each time."**



Cash Standard Class D Pressure Reducing Valve; inexpensive; dependable. Used in regulating steam, hot water, cold water, air, oils, many chemicals and most gases. Sizes ¼" to 2"; screwed ends.

Initial pressures up to 250 lbs., reduced pressures up to 200 lbs. Bodies in iron, bronze or steel. Trim; iron, bronze, stainless steel, monel metal, or nitralloy.



Cash Standard Type 10 Pressure Regulating Valve—self-contained, pilot operated. For holding reduced pressure within extremely close limits.

Sizes: 2" to 12". Initial pressures up to 600 lbs.; highest reduced pressure 250 lbs. For water, air, Freon, ammonia, any non-corrosive gas or oil. Valve operating fluid not wasted: it discharges to outlet pipe.

Bodies: iron, bronze, steel. Trims: iron, bronze, stainless steel, or monel metal. Ends: screwed, flanged, or ammonia type.

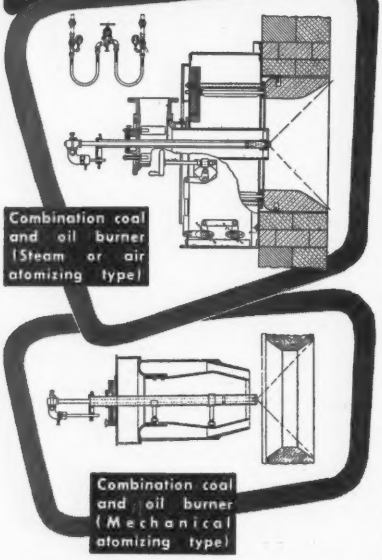
Get Free Bulletins on Above . . . Write to A. W. CASH COMPANY DECATUR, ILL.

6 REASONS

why POWER PLANTS burning pulverized coal should be equipped with

Enco

OIL BURNERS



Combination coal and oil burner (Steam or air atomizing type)

Combination coal and oil burner (Mechanical atomizing type)

ENCO Interchangeable Mechanical and Steam or Air Atomizing Fuel Oil Burners may be installed in almost every type of pulverized coal burner, making a flexible dual fuel system at small cost.

An Enco System gives you these important advantages . . .

1. Ignites pulverized coal.
2. Warms up cold furnaces.
3. Assures continuous operation in event of a breakdown.
4. For banking fire, low load operation or carrying a load varying quickly over wide ranges.
5. No shut-downs in the event of a coal shortage.
6. Lowers cost of operation when all fuel can be obtained at a favorable price.

Enco's list of installations reads like a Who's Who of American Industry. We will gladly show how Enco Oil Burning Equipment can be used with your present pulverized coal burners—there's no obligation. Write The Engineer Company, 75 West Street, New York, N. Y.

Enco Burners

NEWS FROM THE FIELD

Use of reinforced concrete columns in place of steel avoided procurement problems and made possible completion of a 400 by 62 ft. shop in 6 wk. at one of General Electric's plants recently. By this and the use of reclaimed beams of hard pine, an estimated 150 t. of steel were saved. Reclaimed steel beams were also used for a 10 t. crane runway.

The building's reinforced columns are at 20-ft. intervals along either side, and are 17 ft. 10 in. high, 2 ft. 9 in. by 1 ft. 3 in. Asbestos shingles wall the structure with 64 per cent steel sash window space. There is a 2 in. plank roof, and the shop floor is poured concrete.

Nearly three quarters of a million dollars is being spent by the city of Taunton, Mass., for expansion of its municipal power facilities. A new 900 lb., 825 deg. F. 5,000-kw. topping turbine will exhaust the 200 lb. header. The 170,000 lb. per hr. boiler designed for oil or pulverized coal firing is of the semi-outdoor type. This construction, it is estimated, saved some $25,000 in building costs at an increased boiler cost of only $2000 over conventional modern construction.

To meet increasing needs of new war industries, contracts were recently awarded for additional building facilities for a 90,000-kw., 1350 lb. pressure extension to Twin Branch Station at Mishawaka, Ind. The station is owned by the Indiana & Michigan Electric Co., unit of the American Gas & Electric System. The new capacity is scheduled for operation in 1943. The capacities of Twin Branch Station originally 80,000-kw. was increased by 76,500-kw. placed in operation in 1941.

The 33rd Annual Meeting of the National District Heating Association will be held at The Dayton Biltmore Hotel, Dayton, Ohio, June 11 and 12, 1942.

Plans are being developed for the Exposition of Power and Mechanical Engineering, Grand Central Palace, New York, November 30th to December 5th.

As an aid to increasing production of war materials, displays will show ways and means of better utilizing existing facilities and the latest methods and equipment for the generation, transmission and utilization of power. Already 100 leading manufacturers have engaged space to show what they are doing to help in promoting greater production of war materials.

Management is by the International Exposition Co, Grand Central Palace, Charles F. Roth, Manager.

Ray C. Sackett joined the headquarters staff of the Society of Automotive Engineers on March 9 to assist in the accelerating SAE war program. He will have his headquarters in the New Center Building, Detroit,

ABP

What This Symbol Means To You

Banded together in The Associated Business Papers, Inc., is a group of 140 dominant business publications serving virtually every industrial, professional and merchant group in the land. We believe that it is in the best interests of our subscribers to align *Power Plant Engineering* with these leaders who are pledged to uphold the highest standards in publishing and editorial content. Through the constant exchange of publishing lore in our association with them, we can be of greater value to our readers.

Although approximately 1600 so-called business papers are listed in various references, the standards of publishing practice maintained by members of The Associated Business Papers, Inc., are so rigid that less than 200 of this total group qualify for membership.

For one thing, qualifying papers must maintain membership in the Audit Bureau of Circulations, whose impartial audits show advertisers exactly how many interested readers, like yourself, voluntarily pay for their business papers. And each A.B.P. publication must be independently operated, editorially unfettered, ethically administered.

***Power Plant Engineering* is proud of its membership in the A.B.P. and of the publishing standards which help to make it an accepted authority in the field of power generation, transmission and utilization.**

introducing Tanalginate...

...a new reactive and protective organic colloid developed to supplement such simple chemicals as phosphates and alkalis in the correct conditioning of boiler feed water... a modern material for a modern method of feed water treatment that will...

(1) Eliminate baked sludge deposits because of the fluidity of the sludge.

(2) Permit increases in permissible boiler water concentrations without affecting the quality of steam.

(3) Minimize foaming and priming through the adsorption of crystalline precipitates.

(4) Decrease blow-down as much as fifty per cent.

(5) Reduce the cost per unit of water treated.

If you are pushing your boilers overtime in an "all-out" for production, now is the time to investigate "*Tanalginate*" before scale, corrosion and carry-over cripples your equipment and boosts your bills. Write to our nearest office for complete information—today.

Send for these handbooks of useful information

Here are three booklets that should interest every engineer concerned with feed water treatment and control. One covers types of water, situations and treatments; another gives complete information on "*Tanalginate*"; while the third includes detailed data on the water testing equipment, conductivity apparatus, proportioning pumps and chemical feeders offered by The Bird-Archer Company. Write for your copies—on your company letterhead, please. There is no cost, no obligation.

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Scientific Boiler Water Treatments
SINCE 1885

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Photograph by Galloway

TIME, BRAIN AND MUSCLE SAVERS

Now if ever is the time to install equipment that will speed production, relieve your designers and save manpower.

Gifford-Wood installations are handling chips and lifeboats; toy soldiers and steel cabinets; loaded shells and machine parts; bulk materials, and packaged goods.

Gifford-Wood advantages include 126 years of specialized experience; undivided responsibility for design, construction and installation; and a professional approach that holds no brief for any given kind of equipment except that which will do the job in the best way.

Data Book No. 200-2 contains 124 pages of ideas that show how to combine special and standard designs for economy.

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Founded 1814
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2480

and will devote particular attention to working with the SAE War Engineering Board.

Mr. Sackett was graduated from the University of Michigan in engineering, and for the past 8 yr., as head of the public relations department of MacManus, John & Adams, Inc., has been responsible for technical interpretation of important automotive products. Previously, he was engaged in similar work in connection with Chrysler, Dodge, De Soto and Plymouth, and earlier with The Studebaker Corp.

Sea Bees for Construction Regiment

THE U. S. NAVY has opened enlistments in construction battalions or C B's, for men with construction experience, to be enrolled in Class V-6 of the Naval Reserve for assignment to headquarters and construction companies. These companies are comprised of draftsmen, mechanics, carpenters, electricians, power plant operators, automotive repairmen, and the like, for shore duty at Naval bases outside the continental limits of the United States. Acting appointments are made of persons between the ages of 17 and 50 in various ratings up to and including Chief Petty Officer, depending on the age, experience and other qualifications of the personnel enlisted.

The enlistment period is for the duration of the war. Salaries range from $36 to $99 a month and include housing, food, clothing, transportation, medical and dental care, and other incidentals, to which enlisted personnel are entitled. An allowance of $34.50 is provided in the case of a dependent for ratings of petty officer, 2nd class or above. However, not more than one dependent may be claimed.

It is anticipated that they will engage in offensive combat and will be prepared and trained to give a good account of themselves.

If you are interested, apply to your nearest Navy Recruiting Station for information, or communicate with Commander E. J. Spaulding, Room 3442, Navy Building, Washington, D. C., for an Application for Enlistment form.

Smoke Prevention Assn. to Meet in June

THE PROGRAM for the June 2-5 meeting of the Smoke Prevention Association of America to be held at the Hotel Statler, Cleveland, Ohio, is being developed with the main object of establishing how "The cooperation of The Smoke Prevention Association of America can help in Winning the War through conservation of fuel and elimination of waste." The theme and trend of the papers to be presented will feature education in the proper burning of fuel to conserve it as a contribution to the war effort.

Among the speakers who have been invited to address the meeting are the following: Samuel B. Ely, Supt. of Smoke Prevention, Pittsburgh, Pa., "Smoke Abatement in War Times"; J. G. Mingle, Indianapolis, Ind., "Chimney Draft"; W. F. Davidson, Research Engineer, Consolidated Edison Co., New York; J. F. Barkley, Supervising Engineer, Fuel Economy Service, Bureau of Mines; Arthur E. Hutchinson, Smoke Abatement Engineer, Cleveland; E. G. Dolezal, Dracco Corp., Cleveland; A.

See page 30 of our new 96-page catalog for information on this

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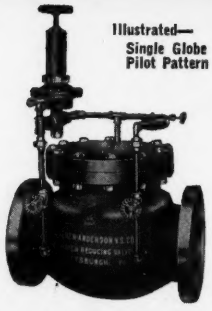

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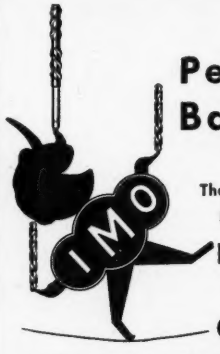

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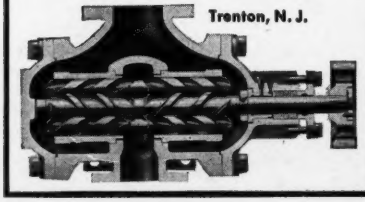

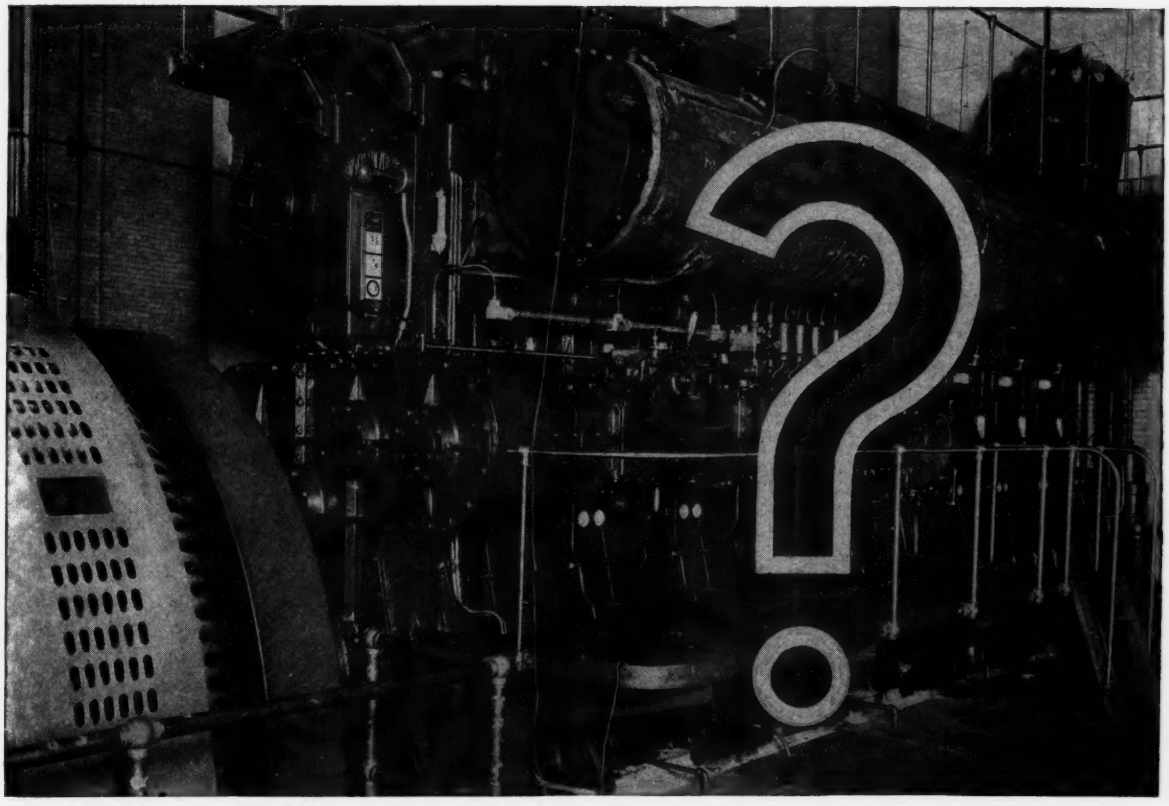

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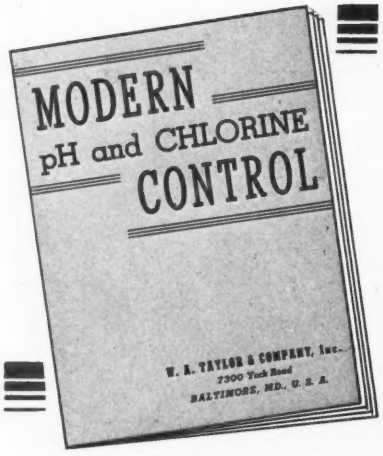

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S. A. E. Meeting

GEARED to the most intensive series of technical discussion on war engineering projects ever staged, the S. A. E. will hold its Annual Summer Meeting in the Greenbrier Hotel, White Sulphur Springs, W. Va., May 31 to June 5. Because of the nature of the papers, none but American and Allied citizens will be permitted to register and attend the sessions, said John A. C. Warner, secretary and general manager of the Society.

The meeting has been telescoped into five and a half days, with morning, afternoon, and evening sessions. Nearly 50 technical committee meetings will be sandwiched in between these formal sessions. All organized golf, tennis, and other sports tournaments, which in the past have been a popular feature of the S. A. E. Summer Meetings, have been canceled. Engineering sessions are expected to run far into the night.

The meeting will be the occasion for consolidating technical progress made by the two score S. A. E. committees which are actively engaged in working on specialized war problems assigned to them by Army ground and air branches, by technical divisions of the War Production Board, the Office of Defense Transportation, and other military and governmental agencies. Programs for further extension of these activities will be summarized and approved, making the months following the meeting the most prolific in war engineering results of any since the S. A. E. war program got under way in 1939.

Kalamazoo Municipal Plant Expansion

THE KALAMAZOO LIGHTING DEPARTMENT, Kalamazoo, Mich., is considering report made by the Hubbard Engineering Co., 616 S. Michigan Ave., Chicago, Ill., consulting engineer, covering recommendations for expansion and improvements in the municipal power station. The proposed program would be carried out over a term of years and is estimated to represent a gross expenditure of about $780,000.

Immediate work to be carried out this year would include extensions and improvements in combustion control; installation of new coal and ash-handling machinery; extensions and modernization of the switchboard; and construction of a coal silo of about 200 t. capacity.

In 1943, program proposes the installation of a new 50,000-lb. per hr. boiler and auxiliary apparatus, estimated to cost about $120,000. Incidental improvements and certain modernization are outlined for the succeeding year, to be followed by the installation of a new 3500-kw. turbine-generator unit and accessories, estimated to cost approximately $235,000.

A second boiler unit and another turbine-generator, both of same capacity noted, are to be installed in the yearly periods following, to cost close to $305,000. Prior to that time, it is proposed to build an addition to the station for expansion in turbine room to accommodate the new units. The entire program provides for an increase in station capacity from 2700 to 10,500-kw.

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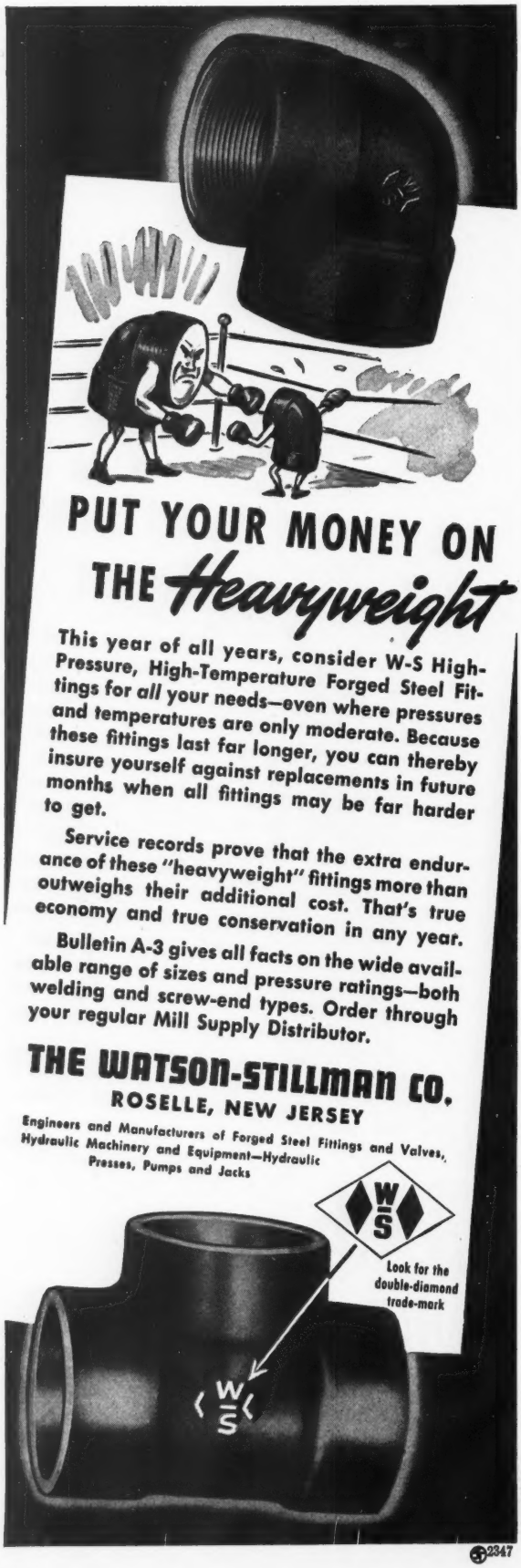
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P.G.&E. Makes Offer for Power

AN OFFER, said to approximate $6,000,000 a year, was recently made by the Pacific Gas & Electric Co. for the entire output of the Shasta and Keswick hydro plants in the Central Valley Project in California being built by the Bureau of Reclamation. The power will be available late in 1944 or early in 1945.

The market provided by the P. G. & E. system would make it unnecessary for the Bureau to construct transmission lines or a steam plant and would thus save critical materials. Last spring Congress cut from the Bureau's 1943 budget appropriations nearly $14,000,000 included for transmission lines and a steam plant at Antioch.

Proposed Federal Plants in Idaho

BONNEVILLE POWER ADMINISTRATION, Guardian Building, Portland, Ore., has recommended the construction of a new hydroelectric generating plant on Clarks Fork River, Bonner County, Idaho (near Cabinet, Ida.) and it is expected that appropriations to begin the development will be made available in the near future. Surveys have been made and preliminary plans are already under way. The project will consist of a large power dam, with a hydroelectric generating station, to be equipped for an ultimate capacity of 100,000-kw. Transmission lines will be built for later connection with the Bonneville high-tension system, as well as power substations, switching stations and other operating structures. The entire project is estimated to cost about $15,000,000.

Deny Federal Funds to Municipality

WRIGHT L. FELT, regional director of the Defense Public Works agency for Los Angeles recently denied the application of the city of Provo, Utah, for $1,828,000 (half loan and half grant) for the expansion of its facilities as mentioned in the February issue p. 74.

Controversy Over Power for Camp

AWARD of a War Department contract for the power supply to Camp Gruber, under construction near Muskogee, Okla., to the Oklahoma Gas & Elec. Co. for 10.8 mills per kw-hr. was contested by the government operated Grand River Project. The federal project is said to have offered a sliding scale of from 4.5 to 6.2 mills. The decision is said to have been influenced by consideration of the taxes paid by the private utility and the smaller amount of critical materials that would be neeeded.

Man Power Survey

EARLY in April 4-p. questionnaires for the nine million men who registered under the Selective Service System on February 16 were sent from Washington as the first step of an occupational census which will make possible for the first time an accurate and practicable budgeting of the Nation's manpower. Answers to the questions will enable the Government to determine what kind of work every man is best fitted to do, whether in the Army or in war production.

Federal Administrator Paul V. McNutt pointed out that eventually every man in the country between the ages of 18 and 65, except those who have already been enrolled in the armed forces, will receive one of these questionnaires for the occupational census which is being conducted jointly by the United States Employment Service of the Federal Security Agency and the Selective Service System.

The Employment Service will not be responsible in any individual case for determining whether or not a man should be deferred on occupational grounds or enrolled in the Army. It will be in position, however, to tell the Selective Service authorities whether or not a man has the skills urgently needed by war industries. It is expected that the Selective Service will be guided by this information in deciding the way in which a man can best contribute to the war effort. Thus the Employment Service will provide the Selective Service with current information on the need for workers for war production so that these needs may be taken into account in classifying registrants for military service.

Forms are in two identical parts; one will be retained by the Selective Service and the other will be forwarded to one of the local offices of the United States Employment Service. The one sent to the employment office will be examined with a view to seeing which men are already qualified or can be quickly trained for work in essential war industries. Such men will be called to the employment office for an interview as to possible jobs in war production.

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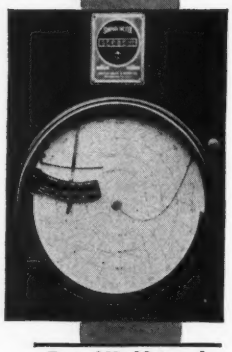

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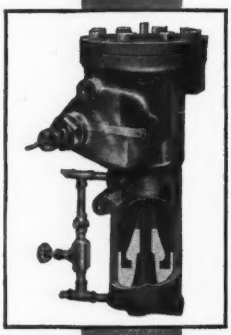
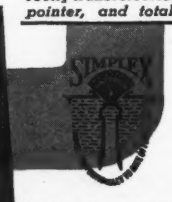


Bell-shaped float is sensitive to smallest change in diff. pressure and directly transfers it to pen, pointer, and totalizer.



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Salvaging Scrap to Win the War

By Ray Schmidt

THERE IS a new slant today on the necessity of keeping scrap losses down. Before priorities, salvage was entirely on a cost basis and the amount of money saved decided how much was spent on salvage. Now, it's different for cost, in many cases, is held second because conservation of materials is a matter of self-preservation. In all Westinghouse plants we have consistently hammered the point home to our employes that our very jobs depend on efficient usage of time, materials, and tools.

In many cases, we are being forced to substitute more expensive materials, and this boosts unit cost. Reduction of waste and efficient salvage thus become even more important; they help maintain unit cost by partly balancing the expense of substitution, and the manufacturer is better able to meet competition prices.

It is said that salvage programs are fine for large plants but aren't practical for small ones. Large or small, there are opportunities for salvage that are overlooked. Last summer, I was in one shop after another, some of them right here in Cleveland, where ferrous and non-ferrous materials were badly mixed. Tool steel and nickel bearing steels were mixed with machine shop turnings and borings. The man who buys these discards will pay only for the gross weight at the unit price of the most inferior metal in the lot.

The organization of the plan to conserve and reclaim materials starts with design and ends with disposition of scrap. For discussion, I have divided the subject into five parts. Namely, simplification, standardization, substitution, reclamation, and disposition.

Simplification

The whole program must be organized from start to finish from the design engineer down to the lowliest workman. The engineer must design only to meet the requiremnts of the piece or apparatus. The design should be around accepted material standards and sizes to eliminate short ends. Scarce and critical materials must be avoided wherever possible. Check design to eliminate extra thicknesses, excessive weights. Much of the benefit from simplification is never secured because the manufacturing people are used to working to blueprint and specification. The surest way is to plan at the source.

Naturally, the more types and sizes of product, the greater the problems. Sales, engineering and manufacturing executives should be continually studying the possibilities of reducing these. It is possible to make more of a fewer number of types and sizes with much less investment in materials and machines. So is it also possible to train new employes more quickly and eliminate waste time and motion.

There are over 4,000 SAE steels in existence, of which Westinghouse uses 300. Under present Government plants, there will be a lot less. It is no secret that the military strength of the Axis Powers comes from the establishment of a minimum of types and sizes in everything and then concentration on producing these standards.

Subcontracting is also made difficult by our failure to act more quickly along these lines. There are so many sets of standards that much valuable time is lost in negotiating, comparing, etc.

Substitution

If necessity is the mother of invention, so it is also the father of substitution. There is today no hide-bound adherence to tradition. We use whatever is available to do the job. Most engineers are only too willing to cooperate, and as a result, many alternate materials are being used where even a year ago the suggestion would have met an indignant refusal. Many of these substitutions will be permanent, and in this sense at least, we will be securing good from an evil situation.

Reclamation

Here is a field with tremendous possibilities. The first function of a salvage program is to prevent scrap and here is where the salvage head can make his salary many times over. The application depends largely on the individual problem and quantities involved, but large or small, every plant can use part of the program.

When short ends of sheets, plates and bars are used to make smaller pieces, the gain is equivalent to the difference between the costs of good and scrap material. When lumber is burned

*Supervisor, Reclamation and Salvage Departments, Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa. From a talk presented at the Cleveland Chamber of Commerce, Cleveland, O.

Consolidated Aircraft Corporation's new airplane plant . . . engineered and built by the Austin Company.

KEYNOTE in the construction of this vast plane factory has been "Controlled Conditions." Light, sound, atmosphere . . . all are controlled to provide uniform working and equipment conditions 24 hours per day, 365 days per year.

Worthington's part in this tremendous undertaking has been the furnishing of the refrigerating equipment for the air conditioning system, the fire pumps, and additional pumps for water circulation.

In manufacturing and installing the equipment, it has been our privilege to work closely with the executives and engineers of The Austin Company, and we are pleased to congratulate their organization on this noteworthy achievement.

TODAY, practically the entire output of Worthington's five plants flows directly into the war production program . . . for the Army and Navy themselves, or as essential equipment for the munitions, steel, petroleum, chemical, and many other industries, and as the basic equipment of such vital public services as power, water supply, and sanitation, for concentrations of war workers.

It is significant that Worthington's ability to produce many and varied items of important equipment *now* is the result of having maintained, through past years of prosperity and depression, an organization which is manned and tooled to do its job when called upon in peace or war.

For the solution of war production problems in air conditioning, power generation and transmission, liquid transfer and metering, and construction, Worthington equipment is now available. Our engineers are ready to assist in planning,plant expansion or conversion.

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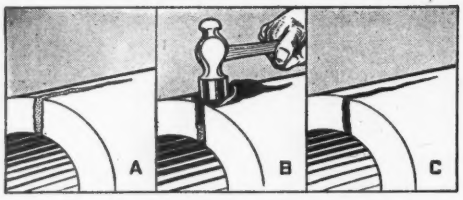

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With SMOOTH-ON, you can stop leaks at seams and joints, seal cracks in casings of pumps, valves, and process apparatus, and tighten loose parts of machines and fixtures, quicker, easier and at less cost than by any other method. SMOOTH-ON repairs do not require dismantling of equipment, or the use of heat or special tools, and the results are lasting.

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Get Smooth-On in 7-oz., 1-lb. and 5-lb. cans or 25-lb., 100-lb. kegs from your supply house, or if necessary from us. *For your protection, insist on Smooth-On, used by engineers and repair men since 1895.*

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and at the same time, new lumber is bought for shipping and packing, the loss is obvious. When old paper instead of excelsior is used for packing, a definite gain is made.

When using any great quantity of oils, paints, and varnishes, it is possible to reclaim by simple and inexpensive means a good part of the waste. The loss of paint in spray booths is considerable. There are simple, inexpensive ways to trap this waste and convert the sludge into usable material.

Foundry operators know how tough it is to secure scrap on the open market. If machines are operated in connection with the foundry, it is often possible to use the scrap pile at hand as a source of supply.

When a study of the scrap received in the salvage department shows a high percentage of the same spoiled parts being received, the head of the manufacturing department, if advised, can often change some method to minimize the spoilage. Often tools are wasted by improper use; wrong methods of cutting are employed. The problem is reflected in the kind of scrap received and is always brought to the attention of those who can correct the condition.

This all sums itself up in the axiom, "Never scrap anything from which some useful thing can be made."

Disposition

In disposing scrap carelessness or ignorance is responsible for some real losses; superior grades of scrap are often mixed with inferior grades. This generally comes from the attitude, "I don't have enough to bother about." Tossed out of the trash pile a little bit at a time, the amount of waste doesn't look like much. But once an effort is made to accumulate the desirable grades, it soon becomes evident how much can be saved. Segregation of certain kinds of scrap usually can begin at the machines where produced.

Men in manufacturing departments argue that their main job is to get out production; there is no time to bother with scrap. Today scrap is a commodity just as is a finished product. It is a by-product that we can't do without. A pound of primary substance contains a percentage of secondary material; e.g., ordinarily 100 pounds of steel contains 66 lb. of scrap. You can readily see what happens when the scrap is not available.

To repeat, the whole program should originate with the design engineer. He might well consider both the function of the product and the day when it will be scrapped. The importance of the workmen's cooperation should be emphasized. Production workers have little, if any, awareness of the value of metals they work with. The foreman's job is to make workers salvage-conscious, and when foremen are thoroughly instructed and sold on the value of a salvage program, they become good missionaries to their workmen. In our company, the suggestion system is used with good effect.

Old Manila Rope Needed for Insulating-Paper

ACTING TO AVERT a threatened shutdown of certain plants manufacturing electrical insulating papers vitally needed for many war purposes, the WPB recently issued an urgent appeal for the salvage of old manila rope.

Six plants produce more than 75 per cent of the Nation's supply of insulating papers and representatives declared that they had on hand only a few weeks' supply of No. 1 old manila rope, from which the papers are made.

This insulating material is used in electrical apparatus such as motors, generators, and transformers, where the strength of manila fiber papers permits a reduction in the size of the apparatus and promotes maximum speed in the application of the insulation.

Dealers are available throughout the country to handle the old rope and move it promptly to the mills which need it.

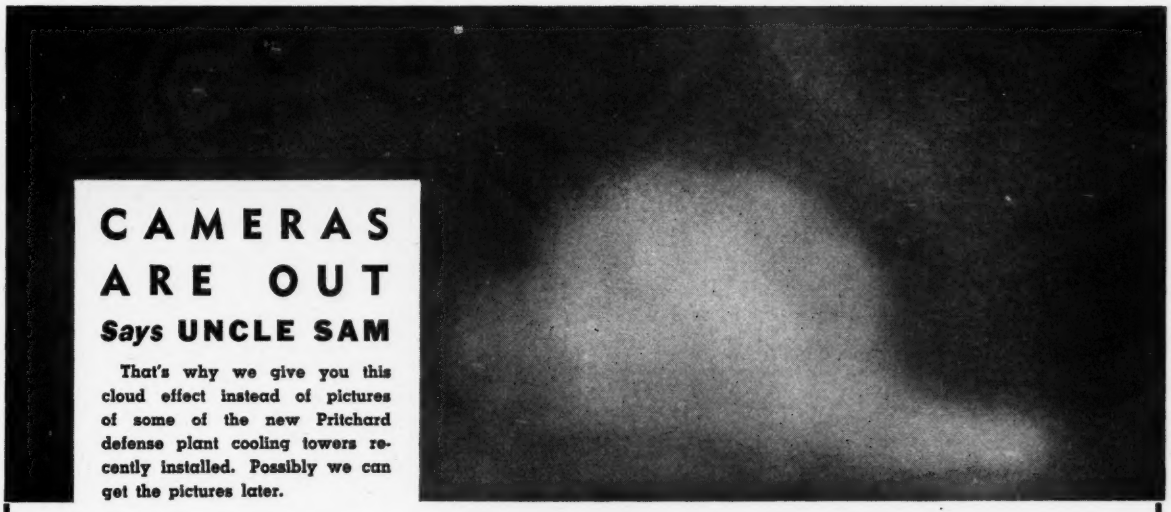
The regional managers of WPB offices were instructed to transmit the appeal to industrial salvage committees in 58 key cities. The committees, in turn, will be instructed to emphasize the old rope shortage to persons in charge of salvage operations in some 30,000 plants, mines, mills, and public utilities.

Gas and Oil Gain in Importance

COAL remains the dominant source of energy in the United States, but it is rapidly losing ground to petroleum and natural gas, a report of the Bureau of Mines reveals.

The total available fuel and power energy in 1940 almost equaled the amount available in 1929, the peak year. In terms of coal, fuel and power production of all fuels was 884,224,000 net tons in 1929, compared to 879,324,000 net tons in 1940.

Coal accounted for 66 per cent of the total in 1929, only 54 per cent in 1940, while crude petroleum and natural gas energy rose from 31 per cent to 42 per cent of the total. Hydro-



CAMERAS ARE OUT
***Says* UNCLE SAM**

That's why we give you this cloud effect instead of pictures of some of the new Pritchard defense plant cooling towers recently installed. Possibly we can get the pictures later.

BIG ORDERS FOR EFFICIENT EQUIPMENT

VERY recently some of the largest cooling tower orders ever placed have been for Pritchard mechanical draft equipment.

These towers were bought on the basis of acceptable price, sound construction, economical operation and low cost per year of service, including both operation and maintenance.

Other buyers who want these advantages in water cooling equipment will always find them in Pritchard mechanical draft towers.

Bulletins 42 and 42-A tell you why. Write for them today

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WATER COOLING TOWERS

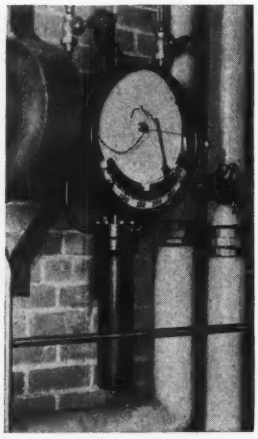
KEEP ACCURATE COSTS

for STEAM, WATER COMPRESSED AIR or GAS

Get the data you need for allocating costs from these direct-reading, evenly-divided charts —recorded with exceptional accuracy at all rates of flow and TOTALIZED on the ADSCO Flow Meter.

Despite its high sensitivity to fluctuation in flow, the ADSCO Flow Meter is so simple and rugged that it cannot be damaged by sudden overloads or reverse flows — is easy to install and maintain.

Available with (1) recording chart, (2) indicating scale and (3) integrator counter to totalize the flow or other combinations thereof. Write us regarding your metering problems—also ask for Bulletin 35-83E.



AMERICAN DISTRICT STEAM COMPANY NORTH TONAWANDA N. Y.

Making "UP-TO-DATE" Steam Line Equipment For Over 60 Years

LET ADSCO FLOW METER TELL YOU HOW MUCH . . . WHEN . . . WHERE

electric power increased from 3 to 4 per cent in the same period.

The Bureau's report cautions that no attempt is made to equate these fuels and power sources on any basis except B.t.u. content, and further that for many uses they are not competitive. Less than one-half of the output of petroleum and about one-half of the production of natural gas are strictly competitive with coal, the report states.

"Firefly Lighting" for Emergencies

WALLS AND ceilings of cold "firefly light" made possible by newly developed phosphorescent chemicals, can now provide emergency lighting for ships, air raid shelters, and vital public buildings, according to E. W. Beggs, Westinghouse lighting engineer. Chemical lighting developed for blackouts and power failures, has proved in laboratory tests sufficient for all ordinary movement in a darkened room and in many cases to distinguish objects and even for reading a watch.

An instantaneous flash of bright light like that from a photoflash lamp is sufficient to charge up a phosphor coated wall for as long as eight or nine hours. These phosphors, which generally emit a green or blue illumination, act like storage batteries, soaking up a great quantity of light and then releasing it slowly. A wall 15 ft. long and 10 ft. high, for example, would radiate about seven and a half lumens of light. An ordinary 25-w. lamp gives off 260 lumens by comparison.

When a bright light is played on a phosphorescent material, microscopic light particles are showered into a mass of tightly packed phosphor atoms. Each of these atoms has electrons spinning around it like tiny satellites. Light particles which score "hits" on phosphor atoms destroy the natural order and send the satellite electrons spinning out of their orbit. In returning to their normal position, millions of these electrons create flashes of illumination which light up the material in some cases over a period of hours. Fluorescence, generated by ultra-violet rays, works in the same manner except that the action of the electrons ceases when the ultraviolet is removed and the glow of light disappears instantly.

Steam Trap Life and Performance

FOR LOW COSTS, the first step is systematic maintenance, and this depends on proper installation. Location should be below and close to the unit of radiation in an accessible location, for according to an article in the Armstrong Trap Magazine hard-to-get-at traps are likely to be neglected.

If impossible to install below the radiation unit, a water seal should be provided at the low point with a check valve to prevent back flow of priming from the trap. Dirt pockets or strainers ahead of the trap may save trouble and steam loss, especially with pipe coil radiation where scale may be dislodged from the pipe by contraction and expansion.

Bypasses are usually unnecessary with heating units, but for a large unit heater may be advisable. Uniform connections as to distance and direction of unions are of value for each size and trap to facilitate interchange for needed repairs.

Test outlets are important, as close as possible to trap discharge, with check or stop valve on the discharge side of the trap to prevent improper indications of the test valve due to back pressure in the return line.

Molecules Wriggle in Electric Fields

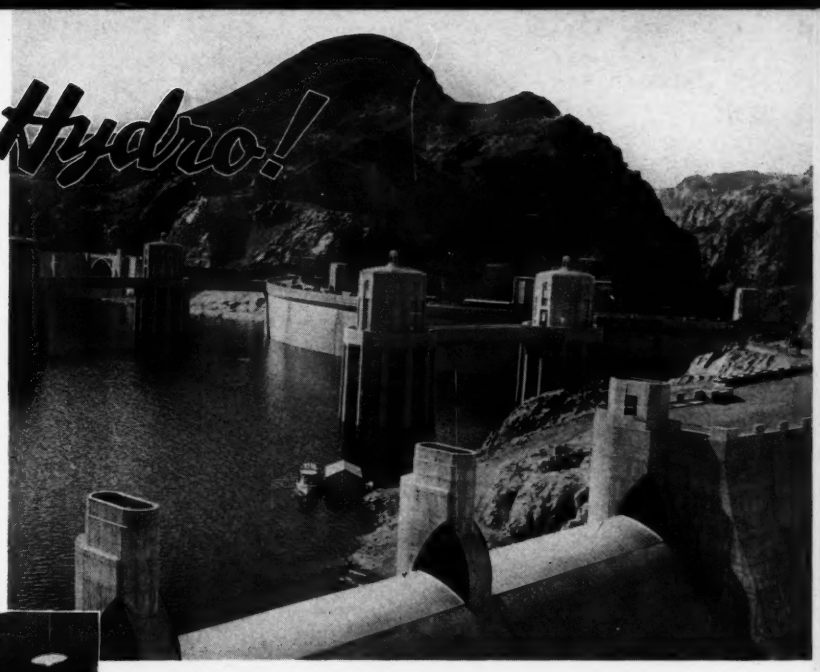
SOME MOLECULES wriggle like worms when an alternating electric field is applied to them, Dr. Raymond M. Fuoss, of the G. E. Research Laboratory has found. These long worm-like molecules have many useful applications and they are becoming increasingly important in such fields as artificial silk and rubber as well as many plastics. This is especially true of those with electrical applications because of their insulating ability.

The force required to make them wriggle gives the scientists information as to their weight and structure. Knowing how they are built, new molecules can be designed, with properties to meet specific needs. Such molecules, like many in nature, are electrically lopsided, or "polar." The total electric charge on such a molecule is zero, but one side is positive, the other negative. Thus, in an electric field, they tend to line up, just as compass needles line up with the magnetic field of the earth.

Water is an example. The molecule forms a triangle with the two hydrogens, which are positive, at the base, and the single oxygen, which has a double negative charge, at the apex. Because unlike poles attract, these line up in the electric field with the negative oxygen pointing in the direction of the positive electrode.

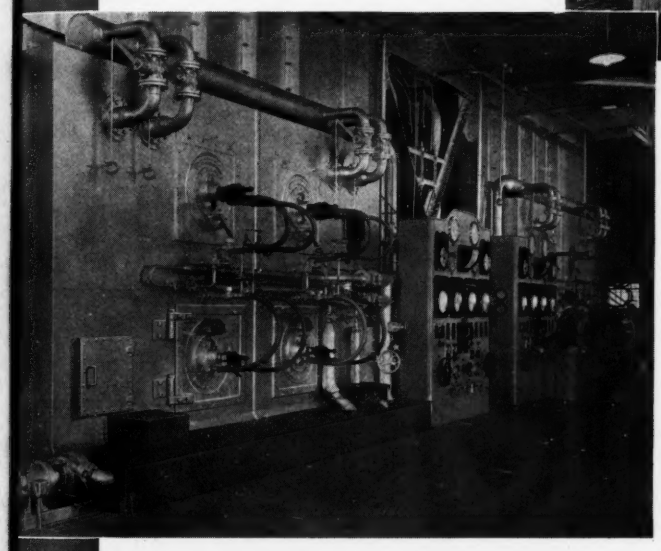
Many of the plastics which have come into such wide use in recent years consist of chains of atoms, called "polymers."

Standby to Hydro!

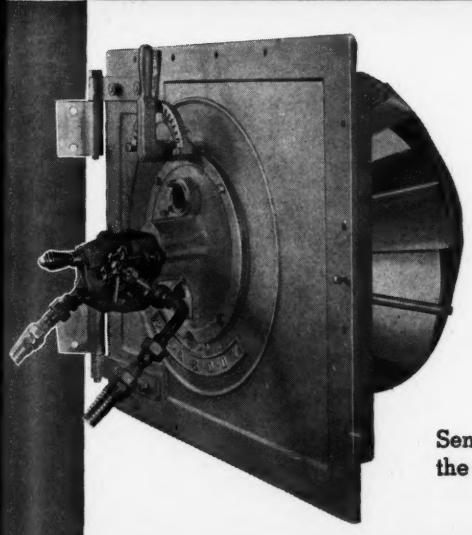


PEABODY
WIDE RANGE BURNERS

Provide Immediate Load Pick-up



The Southern California area is normally served with power generated at Boulder Dam. Should this supply be interrupted or become inadequate at any time, there would be no stoppage in continuous service, for several central stations, equipped with Peabody Combined Gas and CD (*Constant Differential*) Wide Range Oil Burners would pick up the load instantly.



PEABODY WIDE RANGE BURNERS are in hundreds of plants which normally provide high kilowatt output, yet must be ready to handle load variations adequately and economically. These burners have established a new and higher standard of performance over an unbelievably wide range of capacity—when required, in excess of 50 to 1.

Send for new bulletins which describe Peabody Wide Range Burners and the CD Wide Range System fully. If you have a combustion problem, tell us your requirements and get our recommendations.

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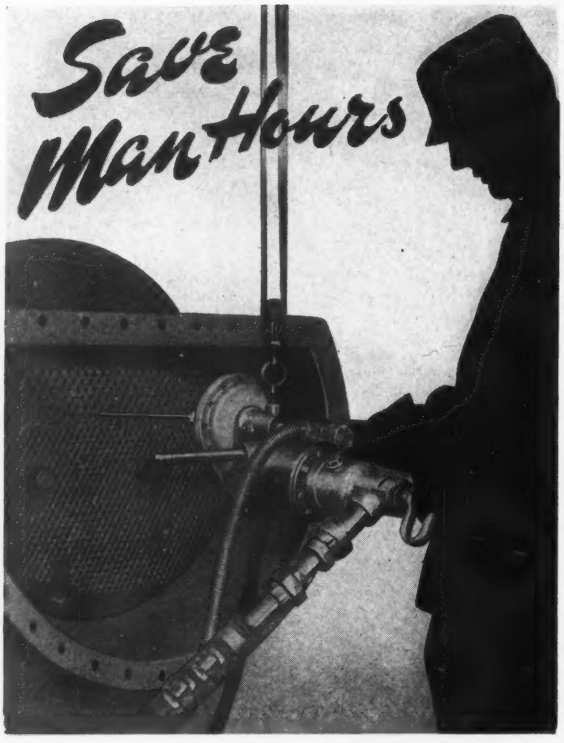

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There are two reasons why your essential tube cleaning jobs are finished quicker with Airetool Cleaners. The new power seal in their motors has made them far more powerful. And, the alloys that go into wearing parts are the result of years of study and experimentation to determine the most suitable. Time and money lost in maintenance is at a minimum.

ALL SIZES ½" to 20" I.D.

Airetool Cleaners are made for all sizes tube or pipe from ½" to 20" I.D., straight or curved . . . air, steam or water driven. Airetool self-feeding cutter heads are equipped with non-tracking cutters.

WRITE FOR BULLETIN PE-14

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Though the entire molecule may consist of hundreds of thousands of atoms, the separate links contain relatively few. Some of these links are unaffected by the electric field, while others are polar, and they respond. The entire enormous molecule is too big to move as a whole but, when an alternating field is applied, the separate sections move to and fro.

These polymers are important as dielectrics, used either as insulating materials or in electrical condensers. Their resistance to wriggling causes heating of the dielectric, which means a waste of current. Consequently the best dielectrics are those in which the wriggling occurs most easily, or in which the polar groups are entirely absent.

The field of high polymers seems to suggest the possibility of designing matter with predetermined electrical and mechanical properties, much as the metallurgist now designs alloys with special properties for specific purposes.

Methods of Testing Belting Leather

PHYSICAL and chemical properties of 17 samples of flat, vegetable-tanned commercial belting leather have been studied recently by Robert B. Hobbs and Philip E. Tobias, of the Bureau of Standards' Leather Section, in connection with a proposed revision of Federal Specification KK-B-201. This specification requires that the stretch at a stress of 2500 lb. per sq. in. be determined on the specimens used for the tensile-strength tests, but does not state whether the machine should be stopped for this measurement. The results of this study indicate that the measurement should be made while the machine is running.

A direct development of the work is a new, simplified method for testing the cementing of laps and plies. The necessary equipment consists of two pairs of jaws, one fixed and the other movable, and suitable weights. The former method required a type of testing machine which was available only in a few laboratories.

In general, the physical characteristics of the samples tested conformed fairly well to the specification, except that 6 of the 17 had too much stretch.

Of the 15 samples subjected to chemical tests, 6 contained percentages of grease which were not within the limits of the specification, and 4 contained too much acid. The latter difficulty might be overcome by adding small amounts of buffer salts to the leather during the manufacturing process.

Coatings for Protecting Metals from Soil Corrosion

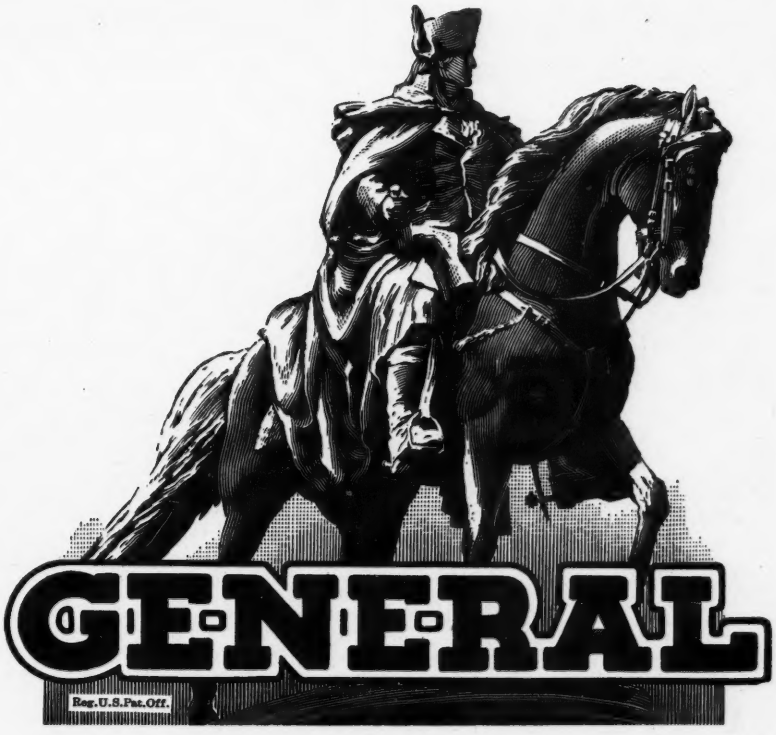
CONCLUSIONS drawn from previous inspections of various metallic and nonmetallic coatings exposed to soils are generally confirmed by the results of recent inspections reported by K. H. Logan in a paper (U. S. Bureau of Mines RP1446) in the January Journal of Research. The protection of steel by zinc coatings depends on the thickness of the coating and is not appreciably affected by the kind of base metal. In a group of mildly corrosive soils, a specially applied coating of approximately 3 oz. of zinc per square foot prevented pitting almost entirely for an exposure period of 16 yr., the duration of the test.

In a group of generally corrosive soils, however, a commercial 3-ounce coating did not entirely prevent pitting over a 2-yr. period. This result is not consistent with previous tests of heavy zinc coatings in corrosive soils, in which pitting was almost entirely prevented for 10 yr., the maximum period of exposure. The suggestion is advanced that uniformity is a prerequisite for adequate protection by zinc coatings in soils.

Lead coatings applied to iron and steel have not proved adequate for protection underground. Since the potential of lead is cathodic to that of iron, lead cannot protect iron or steel in the manner that these metals are protected by zinc. As the rate of corrosion of lead is appreciable under many soil conditions, a continuous layer of lead isolating steel from its environment usually cannot be maintained.

A coating of tin was of little benefit in protecting copper from corrosion in soils. Under certain conditions one or more of the tin-copper alloy layers may be cathodic to copper, a condition which would accelerate corrosion.

The condition and protective value of a variety of experimental coatings after limited periods of exposure are discussed. These coatings include various synthetic resins, chiefly of the phenolic group, various types of rubber and synthetic rubber, vitreous enamel, etc. In this group of coatings, a vitreous enamel and two hard-rubber coatings provided complete protection for 7 yr. A phenolformaldehyde (Bakelite) coating, consisting of several coats of Bakelite varnish, with each coat baked on, provided satisfactory protection for 2 yr., the extent of the exposure.



RODA — High grade gas, by-product and steam coal from Wise County, Va., on the Interstate Railroad.

DENDRON — High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

STONEGA — High grade, high volatile steam and by-product coal from Wise County, Va., on the Interstate Railroad.

PREMIX STOKER — A laboratory controlled product blended to meet exacting stoker requirements. From Wise County, Va., on the Interstate Railroad.

COKE — Roda and Stonega from Wise County, Va., and Connellsville Coke from Pennsylvania.

CRITERION COAL — High grade gas, by-product, steam and domestic coal—Pittsburgh seam from Irwin Basin, Westmoreland County, Pennsylvania, on the Penna. Railroad.

CROZER — Genuine Third Vein Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railroad.

Admiralty Coal — Genuine New River Smokeless, Beckley or Sewell seam from Raleigh County, W. Va., C. & O. and Virginian Railroads.

Old Kentucky — Hazard No. 4 and No. 7 steam and domestic coal from Wiscoal, Knott County, Kentucky, on the L. & N. Railroad.

GENCO — Steam and domestic coals from a number of producing districts.

ANTHRACITE — Premium and standard qualities in the entire range of Anthracite burning characteristics.

Capable engineering personnel and the experience gained through long and varied marketing activity assures proper application of one of the above brands and effective servicing of any fuel requirement.

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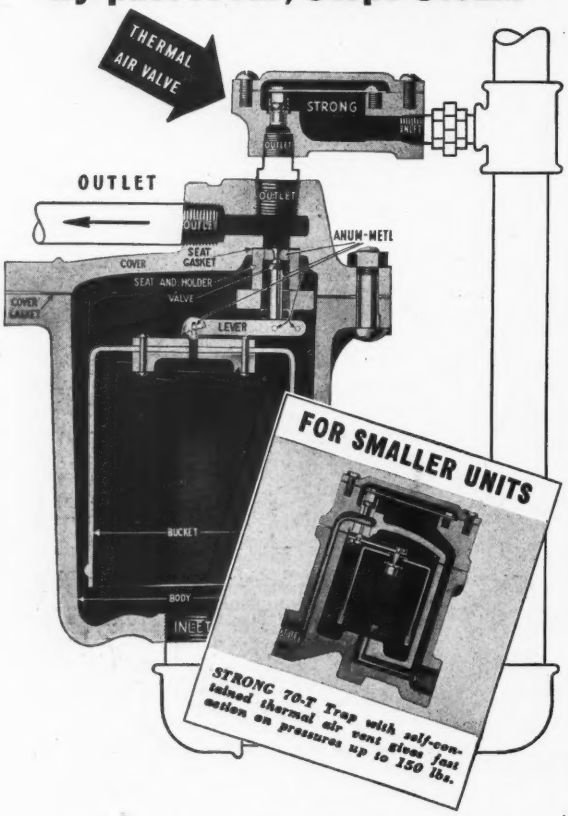
By-passes Air, Stops Steam



STRONG stopped using a thermal air vent on the trap bucket years ago. Reason: air had to pass through the trap discharge valve, which limited the air capacity and slowed up heating.

STRONG'S Thermal Air Valve provides a large, unrestricted air by-pass. You get **FAST ACTION.** Anum-Metl seat and disc, plus the special bi-metal thermal element, insure long, trouble-free service. Write for Catalog 63 for details.

The Strong, Carlisle & Hammond Co.
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13

STRONG
STEAM SPECIALTIES

18,000 Miles of Oil Wells Drilled

AMERICAN oil men in 1941 drilled more than 18,000 mi. of hole, according to a report issued by the American Petroleum Institute. Depth of individual wells range from a few hundred feet to nearly 3 mi. The number of deep wells, drilled more than 10,000 ft. has been increasing since the first one was completed in 1931, but the average depth of all wells has moved only a few feet up and down from 3,000 ft. in the last 15 yr. Since 1931 the petroleum industry has drilled 1044 wells below 10,000 ft., 868 of them in 1940 and 1941. At the end of 1941, 60 others scheduled to pass 10,000 ft. were still drilling. The American Petroleum Institute's Committee on Petroleum Reserves estimate proved that reserves of crude oil in the United States as of Jan. 1, 1942, amounted to 19,589,296,000 barrels, which is 564,781,000 barrels higher than its Jan. 1, 1941, estimate of 19,024,515,000 barrels. This increase in total estimated reserves during 1941 is the net result of the discovery and development, through extensions and additions to old pools, and through the discovery of new pools, of a total of 1,968,963,000 barrels of new oil as against 1,404,182,000 barrels of crude oil produced during the year. These figures include all grades of crude oil and distillate known to be recoverable under existing economic and operating conditions. They do not, however, include any estimate of the reserves which may be found in areas known to be favorable to the accumulation of oil but which are as yet untested.

New Method of Making Fluorescent Lamps

FLUORESCENT lighting, burgeoning under the demands for wartime industrial lighting, received additional stimulus with the recent announcement of a new manufacturing process perfected by engineers of Hygrade Sylvania Corp. The development increases the life and initial brilliance of the lamps and also eliminates subsequent development of dark streaks, splotches or shadowy end-bands, the company says.

Basis of the new process is the explosion of a mercury "bomb" in the interior of the lamp tube during manufacture, thereby regulating exactly the amount of mercury in the lamp, and producing the improved performance claimed for the method.

Fluorescent lighting demands the presence of a precise amount of mercury in the tube, engineers explain. Too little mercury causes the lamp to slump within a comparatively short time, and an excess of mercury fills in the "pores" of the fluorescent coating, eventually causing dark discolorations and blackened end-bands, and reducing the lamp's lumen output.

It was common practice under previous manufacturing methods, to deposit a small amount of mercury in the tube just before it was sealed by a mechanical device working on the principal of an eye-dropper. The machine was not completely accurate or dependable, often depositing too much or too little mercury; this resulted in many rejects, or, if the discrepancy was too small to be detected by regular inspection methods, unsatisfactory performance during use.

The new bomb method makes it practically impossible for a tube to receive an incorrect amount of mercury. The "bomb" consists of a tiny length of mercury filled nickel tubing spot-welded to the probe of one cathode in the tube. Just before the lamp is finally sealed enough heat is applied to explode the "bomb" and the mercury is released in the form of a vapor in the argon-filled interior.

Long sections of the thin nickel tubing are filled to the brim with mercury and then fed into a precision machine which nips them off in the proper lengths. Each length contains the exact amount of mercury necessary. To be doubly certain that no variations exist, the "bombs" are carried under a magnetic device strong enough to attract and remove from the line any which contain even one-thousandth of a gram less than exactly the correct amount required. Since a wholly filled tube represents the exact amount needed, it is obviously impossible to produce a lamp containing too much mercury.

The improvement is credited largely to James L. Cox, young chief fluorescent engineer of Hygrade Sylvania, who is responsible for a number of vital fluorescent developments, including the method of coating tube interiors with a solution of fluorescent materials that made this lighting system commercially practicable. For his work in treating fluorescent powders to yield the greatest amount of light, Mr. Cox has been honored by the National Association of Manufacturers as an inventor whose work has "materially affected the lives of Americans."

The process, which has been granted a patent and is now being announced to the lighting industry, is already in operation in the new fluorescent plant of the company in Danvers, Mass.

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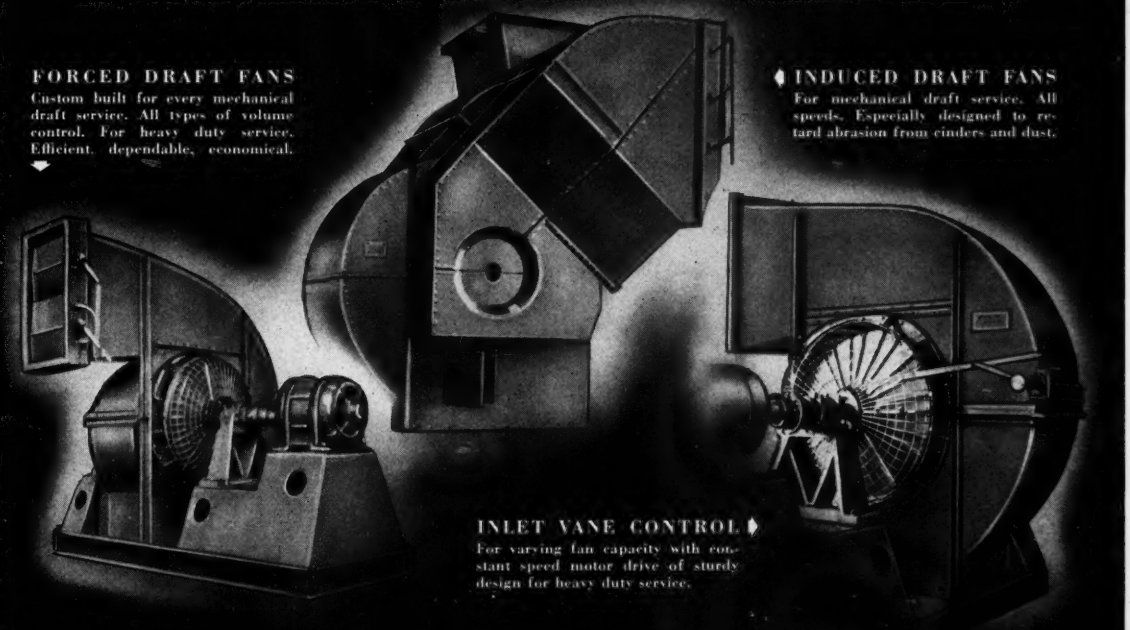
For mechanical draft service. All speeds. Especially designed to retard abrasion from cinders and dust.



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*Venice No. 2 Power Plant—four duplex type forced and induced draft fan units each for first, second and third sections (total 12)

This partial list of recent installations of Green Forced or Induced Draft Fans tells a story—that of our activity in power plants built or modernized for the government as well as for defense industries. There is another fact, however, that we hope you will remember when you are considering the purchase of such equipment.

That fact is this . . . of these fans, many were standard in design, many special—but whether standard or special, each Green Forced or Induced Draft Fan contains *every* refinement in design and construction that only fifty years of specialized experience can build into equipment of this type.

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Lubricating the wheels of industry has been a Bowser specialty for years. Whether you need a single feed lubricator or oiler for one bearing—a filter for an engine or turbine—an overflow sight or a pressure sight feed oiler—or even a huge system for a gigantic steel mill, you will find that it pays to consult Bowser. A staff of trained lubrication engineers is at your service . . . anytime.

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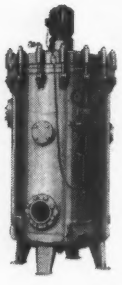
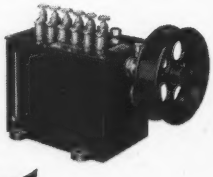


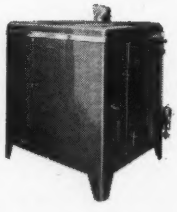
The self-cleaning filter (left) for lubricating oils and coolants has many special features. Various porosities and capacities are available.

The small self-cleaning filter for oils and coolants fills many needs.

Mechanical force-feed lubricators in various types from 1 to 28 feeds are available. Timed lubricators for Diesel cylinder lubrication may be had.

Turbine Oil Conditioners in various sizes for oils requiring acid correction — and to prevent build up of acid in new oil.





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New Engineering Books

Machine Shop Practice. By John T. Shuman. Copyright 1942, first edition, 499 p., size 5½ by 8½ in., cloth bound. Published by the American Technical Society, Drexel Ave. at 58th St., Chicago, Ill. Price $3.50.

The book is a comprehensive treatise on approved shop methods and includes construction and use of tools and machines, details of their efficient operation and a discussion of modern production methods.

Being highly practical and presented in a "how-to-do-it" form, the book also offers the beginner a better understanding of the basic fundamentals and principles involved in modern machine shop practice, and operation of the standard machine tools.

Well illustrated with machine shop practice and operations as they exist in actual shops, the book includes chapters dealing with common hand tools; chipping, filing and scraping; hand threading; linear measurement; fixed gages and their uses; layout tools and how to use them; drilling and milling machines, engine and turret lathes; planers and shapers; and grinding, gearing and broaching.

Each chapter dealing with machine tool operation includes a reference page which has a tabulation of the most common operating difficulties encountered, followed by a probable cause and a suggested remedy. Other features include lists of pertinent questions, reviews and summaries.

Machine construction is dealt with adequately, but special emphasis is centered on the use of tools and machines and the operation of machine tools in common use, with attention to their conservation, care and safety of operation.

Typical Designs for Timber Structures. Published by the Timber Engineering Co., 1337 Connecticut Ave. N. W., Washington, D. C. Size 11 by 16½ in., paper cover, loose leaf binding, original issue 69 pp. Free to engineers and registered architects making a request on company or business letterhead.

Timber, always an important building material, has, due to the present steel shortage, assumed new importance, and the value of this book to engineers and architects cannot be overemphasized. It is a practical working manual giving detailed typical designs, stress diagrams, load tables, and lists of lumber and hardware for many types of common construction.

These include: trussed rafters; Fink, Pratt, Belgian scissors, bowstring, flat and factory trusses; market roofs; grandstands; barrel racks; bridges and trestles; tanks and towers; hangers; and miscellaneous designs widely used in the industrial field. The Timber Engineering Co. is a subsidiary of the National Lumber Manufacturers Association.

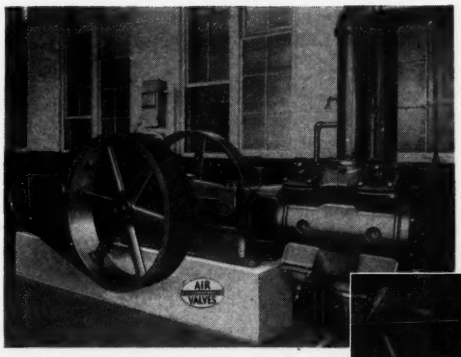
Proceedings of the First and Second Annual Conferences of Municipal Engineers are given in Bulletin Series No. 60 of the Texas Engineering Experiment Station. The conferences were conducted by the School of Engineering, Dept. of Municipal and Sanitary Engineering in co-operation with the League of Texas Municipalities and held at Texas A.&M. College during 1940 and 1941. Twenty-three papers presented at both conferences are included with a registration list of the municipal engineers attending the conferences.

Thin-Walled Metal Construction. Dr. J. N. Goodier, professor of mechanics of engineering at Cornell University, Ithaca, N. Y., is the author of two new bulletins, No. 27, The Buckling of Compressed Bars by Torsion and Flexure; and No. 28, Flexual-Torsional Buckling of Bars of Open Section.

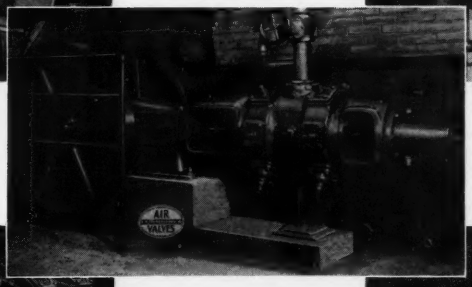
Both bulletins deal with special structural problems brought on by aircraft construction, and present a mathematical analysis of certain peculiar types of buckling which are encountered in tests of aircraft components and may form a basis for design rules which will provide against such buckling.

The bulletins, published by the Cornell Engineering Experiment Station, Ithaca, N. Y., are priced at 50 ct. for No. 27, and 30 ct. for No. 28.

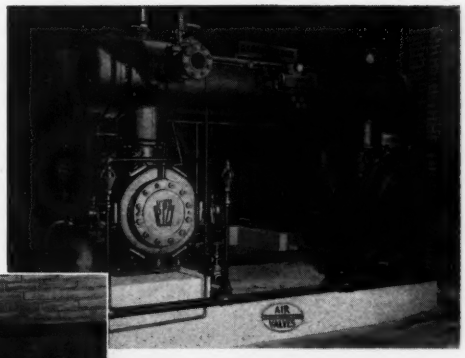
COMPRESSED AIR FOR DEFENSE



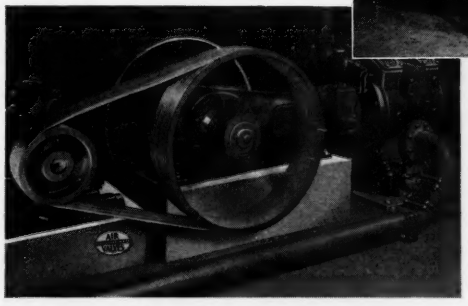
Single-Stage Compressor



Oilfree Air Compressor



Two-Stage Duplex Compressor



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Power Plant Construction News

Ark., Hot Springs—Aluminum Co. of America, Inc., Gulf Building, Pittsburgh, Pa., plans early construction of steam-electric generating station at new aluminum mill at Lake Catherine, near Hot Springs, now in course of erection. New power plant is reported to cost over $1,500,000, with equipment. Entire project will represent an investment of more than $30,000,000. Plant will be operated for production for Government, which will provide financing through Defense Plant Corporation, Washington, D. C.

Conn., Cos Cob—New York, New Haven & Hartford Railroad Co., New Haven, Conn., has plans maturing for extensions and improvements in steam-electric generating station at Cos Cob, including installation of equipment for increased capacity. Cost reported in excess of $400,000.

Fla., Miami—Miami Shipbuilding Corporation, T. C. Buhler, 1320 Venetian Way, president, plans installation of electric power equipment in new shipbuilding plant on waterfront, near Biscayne Boulevard, for construction of vessels for Government. A power house will be built. Entire project will cost about $1,200,000, with financing provided through Federal aid. It is proposed to begin work soon.

Ind., La Porte—Board of Public Works, City Hall, plans installation of turbine pumping machinery and auxiliary equipment in connection with extensions and improvements in municipal waterworks. Phelps & Peck, Brinckmann Building, Michigan City, Ind., are consulting engineers.

Iowa, Sheldon—Iowa Public Service Co., Sioux City, Iowa, has plans maturing for extensions and improvements in power plant at Sheldon, to include installation of new 1400-hp. Diesel engine-generator unit and auxiliary equipment. No estimate of cost announced.

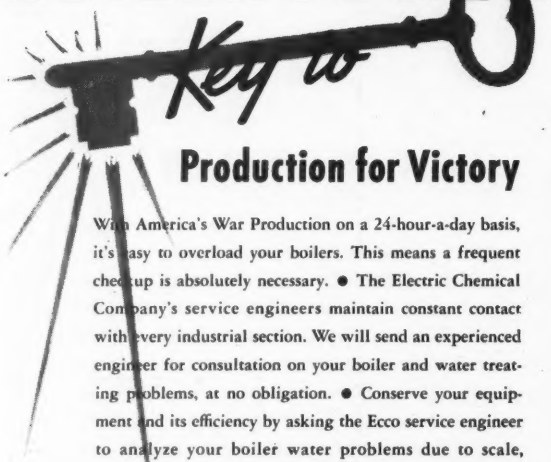
Ky., Louisville—Atlas Powder Co., Delaware Trust Building, Wilmington, Del., manufacturer of powder and explosives, etc., plans installation of electric power equipment in new plant for production for Government on site in McCracken County, Ky., where large tract of land has been secured (exact location and character of production withheld). It will consist of a group of one and multi-story buildings with power house and auxiliary structures. Cost reported over $5,000,000, with financing to be provided by Defense Plant Corporation, Washington, D. C. United States Engineer Office, Louisville, will be in charge.

Minn., St. Paul—E. I. duPont deNemours & Co., Inc., duPont Building, Wilmington, Del., manufacturer of powder and explosives, chemicals and allied products, plans installation of electric power equipment in new plant in Dakota County, Minn. (exact location withheld) for production for Government (exact character of output similarly not announced). It will comprise several large one and multi-story units. A power station is planned. Entire project will cost in excess of $5,000,000, with financing to be provided by Defense Plant Corporation, Washington, D. C.

Mich., Ionia—State Department of Prisons, Capitol Building, Lansing, Mich., plans expansion and improvements in power station and electric light and power facilities at Ionia Reformatory. Cummins & Barnard, State Savings Bank Building, Ann Arbor, Mich., consulting engineers, will make surveys and estimates of cost.

N. J., Jersey City—Public Service Electric & Gas Co., Public Service Terminal Building, Newark, N. J., has approved plans for installation of new boiler unit and auxiliary equipment at West End gas plant, Jersey City, where expansion and improvements are being carried out. Cost reported in excess of $100,000. This is part of 1942 extension and improvement program of company.

BOILER POWER



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N. Y., Buffalo—Farrel-Birmingham Co., 344 Vulcan Street, Buffalo, manufacturer of gears, machinery and parts, etc., plans power house at new plant in Northern New York (exact location withheld) for production for Government. Also will install electric power equipment for plant service. Project will comprise several large one and multi-story buildings, with cost estimated close to $4,000,000. Financing will be provided by Defense Plant Corporation, Washington, D. C. Main offices of company are at Ansonia, Conn.

Ohio, Columbus—Water Department, City Hall, Clarence B. Hoover, superintendent, plans expansion and improvements in waterworks pumping station in connection with extensions in municipal water system, to include installation of new generating unit, two boilers and accessories, one high-lift and one low-lift pumping unit, with auxiliary equipment. Entire project, including pipe lines, is reported to cost close to $1,000,000.

Ohio, Hamilton—Municipal Electric Department plans installation of new boiler unit and auxiliary equipment in municipal power plant. Cost estimated close to $230,000. Specifications are being arranged.

Ohio, Springfield—Thompson Grinder Co., Ziechler Street, manufacturer of grinding machines and kindred machinery, plans boiler house, about 40 by 40 ft., in connection with expansion in plant. Entire project will cost close to $100,000. Proposed to begin work soon. Lloyd Zeller, 2 West Columbia Street, Springfield, is architect.

Ore., Portland—Electric Steel Rolling Mills, Inc., recently organized, care of Morris Schnitzer, 3330 N. W. Yeon Street, plans installation of electric power equipment in new rolling mill on site in vicinity of city. It will comprise several large one-story units. A power station is planned. Entire project will cost close to $1,000,000. Proposed to begin work at early date.

Pa., Erie—Standard Stoker Co., Inc., Gaskill Avenue, manufacturer of stokers and parts, plans installation of electric power equipment in new plant in vicinity of present works for production for Government. Entire project will cost close to $1,000,000. Financing will be provided by Defense Plant Corporation, Washington, D. C. Proposed to begin work soon. Main offices are at 350 Madison Avenue, New York, N. Y.

Pa., Philadelphia—Pennsylvania Salt Mfg. Co., Widener Building, manufacturer of industrial chemicals, plans installation of electric power equipment in new plant in vicinity of city for production of chemicals for war service for Government. A boiler house is planned. Entire project will cost about $1,750,000, with financing to be provided by Defense Plant Corporation, Washington, D. C. Day & Zimmerman, Inc., Packard Building, Philadelphia, consulting engineer, will prepare plans for plant and supervise erection.

Texas, Port Arthur—Neches Butadiene Products Co., care of Gulf Oil Corporation, Gulf Building, Pittsburgh, Pa., recently organized joint interest of last noted company and other oil companies, including Atlantic Refining Co., Philadelphia, Pa., and Magnolia Petroleum Co., Dallas, Tex., plans installation of electric power equipment in new plant in vicinity of Port Arthur, for production of butadiene, a basic petroleum ingredient for synthetic rubber. A power plant will be built. Entire project is reported to cost over $35,000,000.

Wis., Sparta—Sparta Co-operative Association, J. E. Leverich, president, plans boiler house at proposed new 1- and 2-story milk dehydrating plant. Also will install electric power equipment for plant service. Entire project will cost about $135,000. Financing is being arranged through Federal aid. Klinger & Hubbard, 218 South Barstow Street, Eau Claire, Wis., are architects, in charge.

Wis., Waupun—State Department of Public Welfare, Capitol Building, Madison, Wis., plans new boiler plant for central-heating service at State Prison at Waupun. Cost estimated about $50,000, with equipment. Appropriation has been authorized. Roger C. Kirchoff, first noted address, is state architect.

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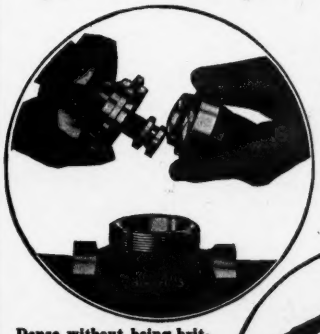

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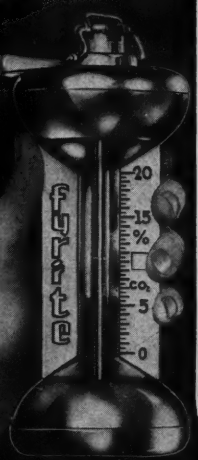

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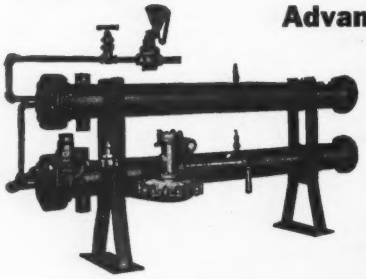

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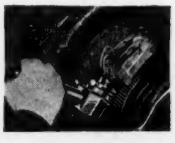

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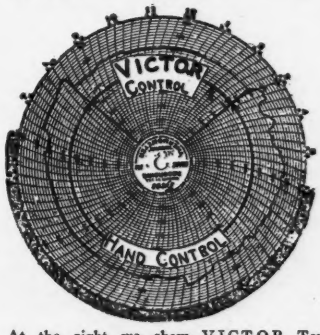

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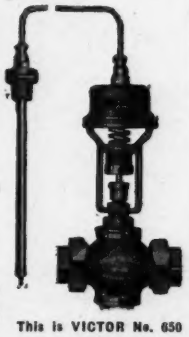

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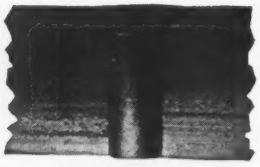
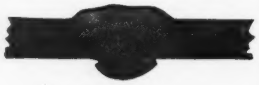
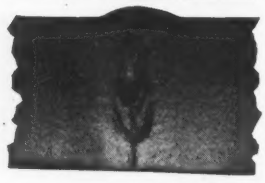




100%
penetration



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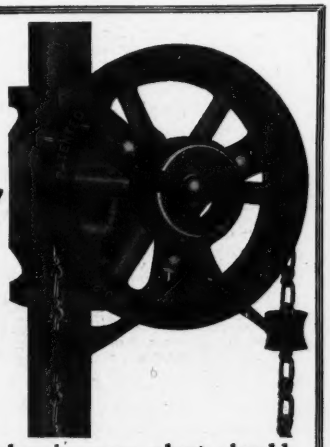

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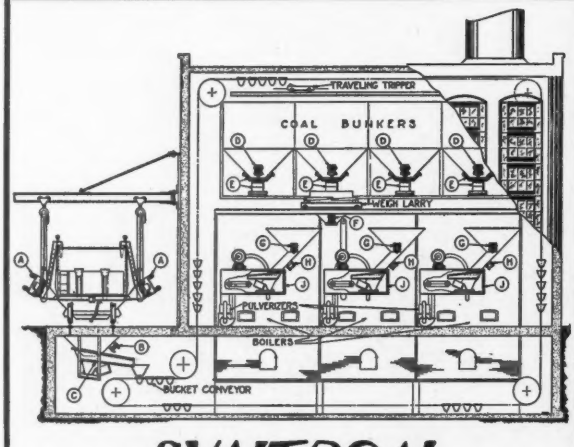

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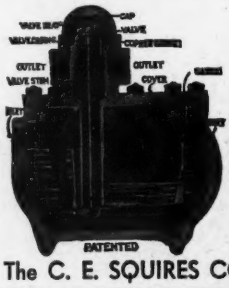

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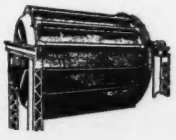

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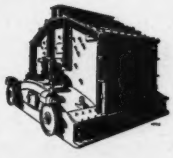

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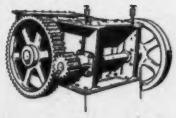

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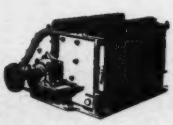

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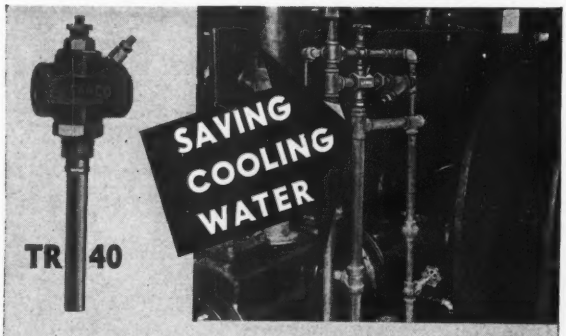

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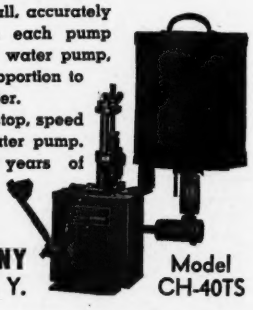

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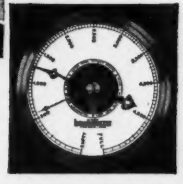

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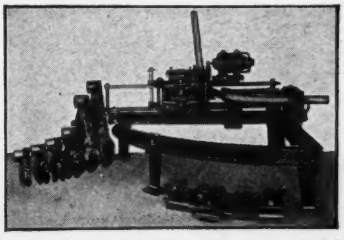

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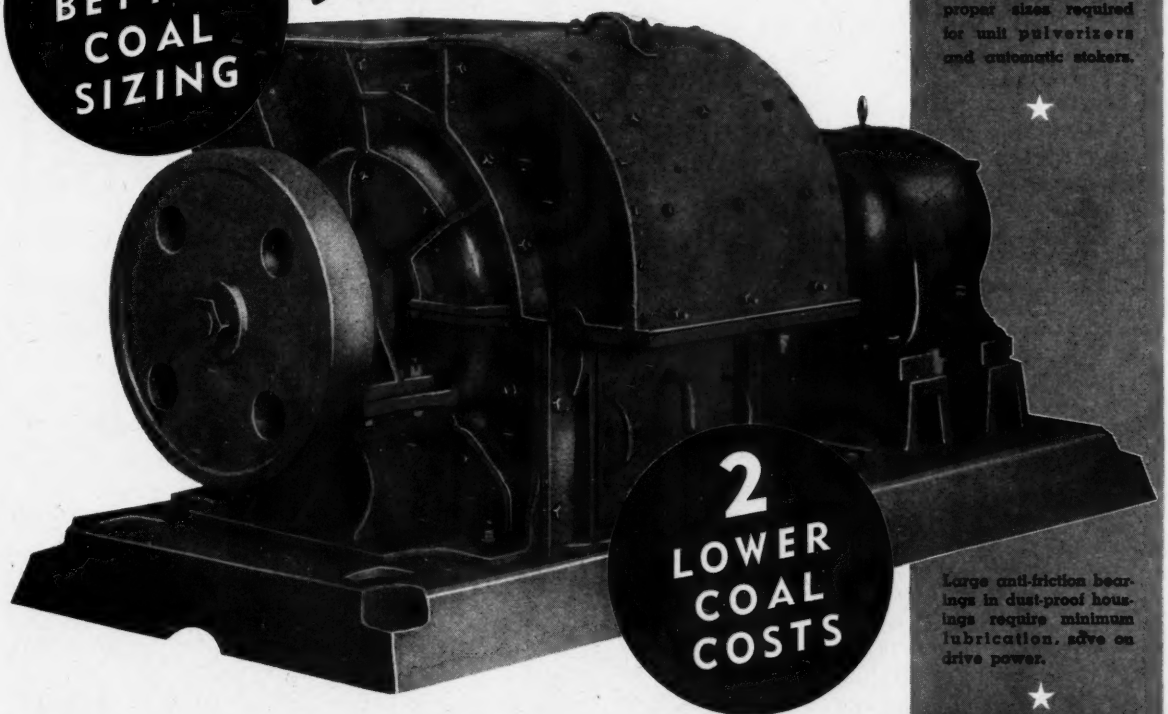

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They find the use of AMERICAN RING CRUSHERS promotes increased boiler efficiency by reducing available coal to correct size, thereby cutting down ashpit waste and excess air losses.

AMERICAN RING CRUSHER Type "S," pictured above has set new standards for efficient fuel sizing and trouble-free crusher operation through the use of heavy steel ribbed housing, anti-friction bearings, adjustable grinding plate, reversible manganese steel shredder rings which split coal instead of crushing it.

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NOTE THESE ADVANTAGES

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Simple adjustment of "AMERICAN" patented grinding plate enables you to reduce coal to proper sizes required for unit pulverizers and automatic stokers.

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Shredder rings in "AMERICAN" Crusher splits coal and prevents bothersome clogging.

Reduces run-of-mine or lump to proper size in one operation.

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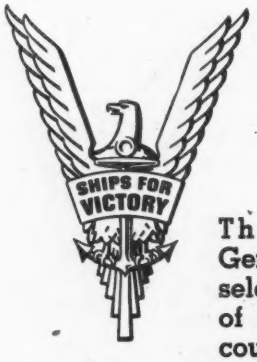

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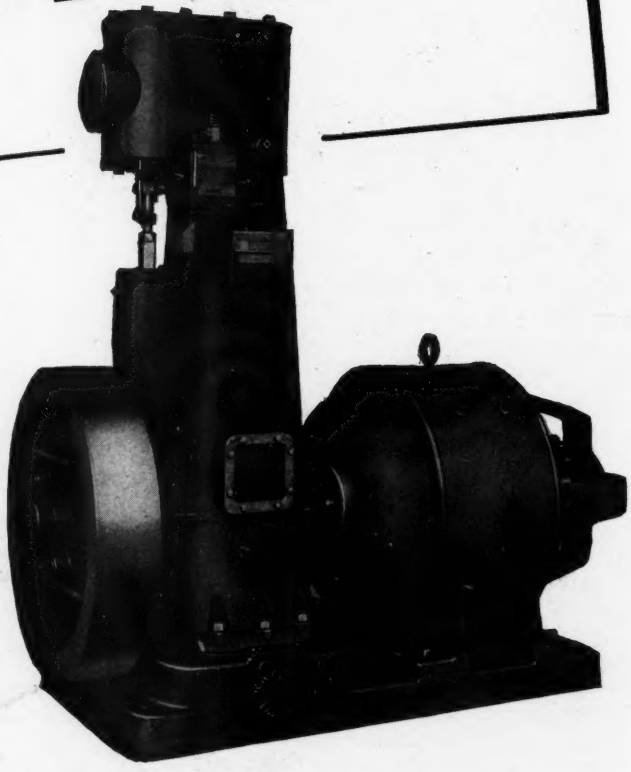

Keep this fact in mind when you are in position to "overhaul" your power setup and we are in position to serve you. Right now we're "up to our necks" on the Liberty Ship program.

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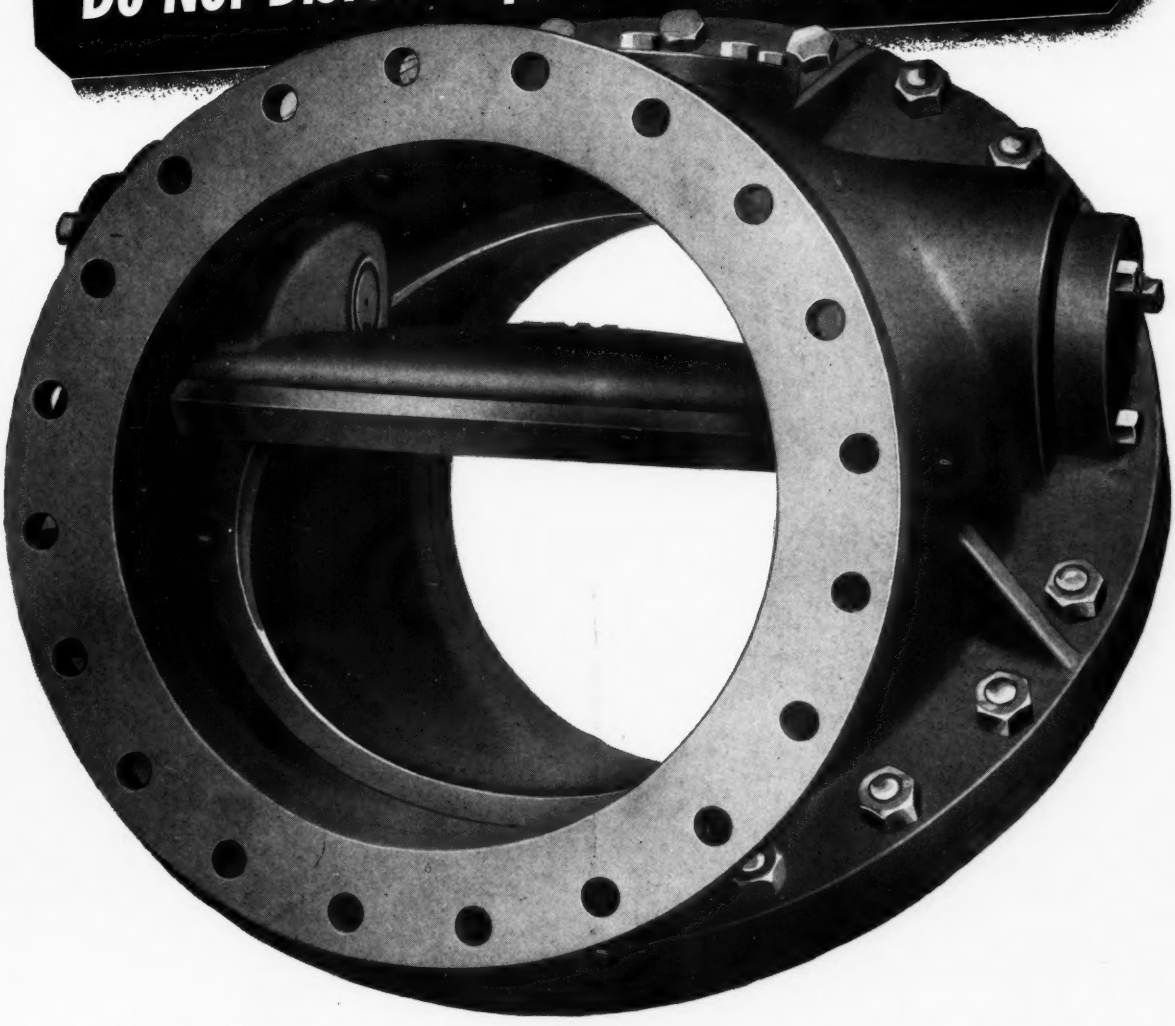
QUIET

Do Not Disturb Pipe-Lines or Flange-Joints



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CHAPMAN *Tilting Disc* NON-SLAM Check Valves

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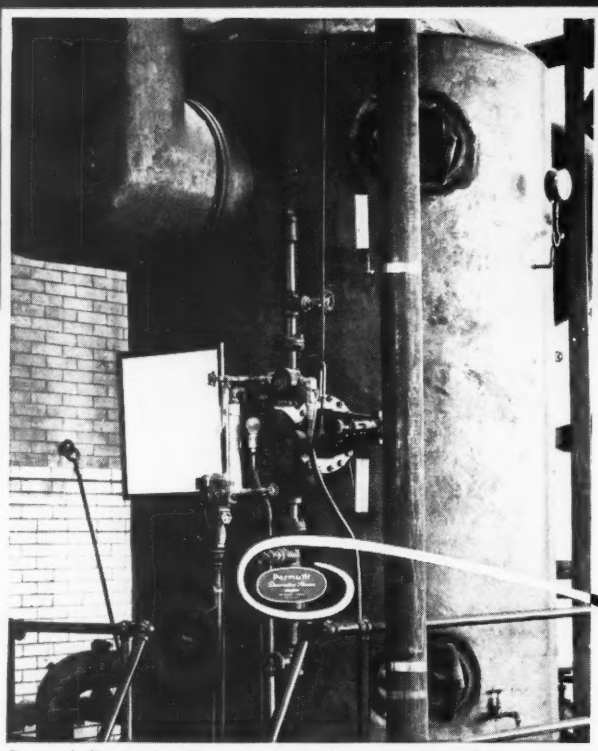
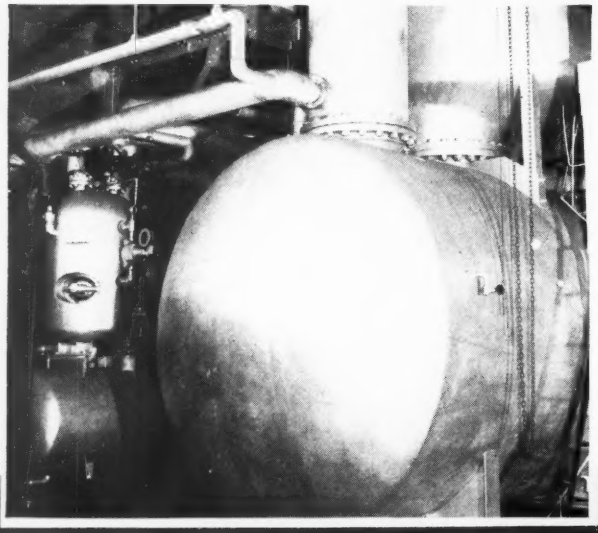
U. S. Navy Yards get positive protection against corrosion of boilers



Permutit Deaerating Heaters in operation at two United States Navy Yards. These are typical of the many Permutit water conditioning installations helping our armed forces—as well as our war industries—to maximum efficiency.



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